

Nutrition and Nutritional Care of Elderly People in Finnish Nursing Homes and Hospitals



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ACADEMIC DISSERTATION

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Merja Suominen, tekijä

Vanhuksen silmissä
hymyilee lapsi.
Kurturuusu kukkii
pakkasiin asti.

Helena Anhava

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LIST OF ABBREVIATIONS

AD	Alzheimer Disease
ADA	American Dietetic Association
ADL	Activities of Daily Living
BMI	Body Mass Index
CGA	Comprehensive Geriatric Assessment
DRI	Dietary Reference Intakes
EAR	Estimated Average Requirements
FFA	Free Fatty Acids
IAG	International Association of Geriatrics and Gerontology
IU	International Unit
FFM	Fat Free Mass
MDS	Mini Nutritional Assessment
MNA SF	Mini Nutritional Assessment, Short Form
MMSE	Mini-Mental State Examination
ONS	Oral Nutritional Supplements
PAL	Physical Activity Level
PEG	Percutaneous Endoscopic Gastronomy
PEM	Protein-Energy Malnutrition
RMR	Resting Metabolic Rate
SENECA	Survey in Europe on Nutrition and the Elderly: a Concerned Action
TEE	Total Energy Expenditure

LIST OF THE ORIGINAL PUBLICATIONS

This thesis is based on the following original articles referred to in the text by Roman numerals I–V

- I Suominen M, Laine A, Routasalo P, Pitkala KH, Räsänen L.
Nutrient content of served food, nutrient intake and nutritional status of residents with dementia in a Finnish nursing home. The Journal of Nutrition, Health & Aging, 2004;8:234–238.
- II Suominen M, Muurinen S, Routasalo P, Soini H, Suur-Uski I, Peiponen A, Finne-Soveri H, Pitkala KH.
Malnutrition and associated factors among aged residents in all nursing homes in Helsinki. European Journal of Clinical Nutrition, 2005;59:578–583.
- III Suominen MH, Hosia-Randell HMV, Muurinen S, Peiponen A, Routasalo P, Soini H, Suur-Uski I, Pitkala KH.
Vitamin D and calcium supplementation among aged residents in nursing homes. The Journal of Nutrition, Health & Aging, 2007;11(5):433–7.
- IV Suominen MH, Sandelin E, Soini H, Pitkala KH.
How well do nurses recognize their elderly patients' malnutrition? European Journal of Clinical Nutrition, (in press).
- V Suominen MH, Kivisto S, Pitkala KH.
The effects of nutrition education on professionals' practice and further to the nutrition of aged nursing home residents. European Journal of Clinical Nutrition, 2007;61:1226–1232.

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ABSTRACT

Background: Malnutrition is a common problem for residents of nursing homes and long-term care hospitals. It has a negative influence on elderly residents' and patients' health and quality of life. Nutritional care seems to have a positive effect on elderly individuals' nutritional status and well-being. Studies of Finnish elderly people's nutrition and nutritional care in institutions are scarce.

Objectives: The primary aim was to investigate the nutritional status and its associated factors of elderly nursing home residents and long-term care patients in Finland. In particular, to find out, if the nursing or nutritional care factors are associated with the nutritional status, and how do carers and nurses recognize malnutrition. A further aim was to assess the energy and nutrient intake of the residents of dementia wards. A final objective was to find out, if the nutrition training of professionals leads to changes in their knowledge and further translate into better nutrition for the aged residents of dementia wards.

Subjects and methods: The residents' (n=2114) and patients' (n=1043) nutritional status was assessed in all studies using the Mini Nutritional Assessment –test (MNA). Information was gathered in a questionnaire on residents' and patients' daily routines providing nutritional care. Residents' energy and nutrient intake (n=23; n=21) in dementia wards were determined over three days by the precise weighing method. Constructive learning theory was the basis for educating the professionals (n=28). A half-structured questionnaire was used to assess professionals' learning. Studies I–IV were cross-sectional studies whereas study V was an intervention study.

Results: Malnutrition was common among elderly residents and patients living in nursing homes and hospitals in Finland. According to the MNA, 11% to 57% of the studied elderly people suffered from malnutrition, and 40–89% were at risk of malnutrition, whereas only 0–16% had a good nutritional status. Resident- and patient-related factors such as dementia, impaired ADL (Activities of Daily Living), swallowing difficulties and constipation mainly explained the malnutrition, but also some nutritional care related factors, such as eating less than half of the offered food portion and not receiving snacks were also related to malnutrition. The intake of energy and some nutrients by the residents of dementia wards were lower than those recommended, although the offered food contained enough energy and nutrients. The proportion of residents receiving vitamin D supplementation was low, although there is a recommendation and known benefits for the adequate intake of vitamin D. Nurses recognized malnutrition poorly, only one in four (26.7%) of the actual cases. Keeping and analysing food diaries and reflecting on nutritional issues in small group discussions were effective training methods for professionals. The nutrition education of professionals had a positive impact on the energy and protein intake, BMIs, and the MNA scores of some residents in dementia wards.

Conclusions: Malnutrition was common among elderly residents and patients living in nursing homes and hospitals in Finland. Although residents- and patient –related factors mainly explained malnutrition, nurses recognized malnutrition poorly and nutritional care possibilities were in minor use. Professionals' nutrition education had a positive impact on the nutrition of elderly residents. Further studies describing successful nutritional care and nutrition education of professionals are needed.

TIIVISTELMÄ

Ikääntyneiden ihmisten ravitsemus ja ravitsemushoito suomalaisissa vanhainkodeissa ja sairaaloissa

Tausta: Ravitsemukseen liittyvät ongelmat ovat tavallisia vanhainkodeissa ja pitkäaikaissairaaoloissa asuvilla. Virhe- ja aliravitsemus heikentää iäkkäiden vanhainkotiasukkaiden ja sairaalapotilaiden terveyttä ja elämän laatua. Ravitsemushoidolla näyttää olevan myönteisiä vaikutuksia ikääntyneiden ravitsemustilaan ja hyvinvointiin. Suomessa ikääntyneiden ravitsemusta ja ravitsemushoidon mahdollisuuksia on tutkittu vähän.

Tutkimuksen tarkoitus: Tutkimuksen tarkoituksena oli selvittää vanhainkodeissa ja sairaaloissa asuvien ikääntyneiden ihmisten ravitsemustilaa ja siihen yhteydessä olevia tekijöitä. Erityisesti haluttiin selvittää, onko hoidolla ja ravitsemushoidolla yhteyttä ravitsemustilaan. Hoitajien kykyä tunnistaa heikentynyt ravitsemustila myös kartoitettiin. Lisäksi tarkoituksena oli arvioida dementia- ja demensioasuntojen asuvien vanhusten energian ja ravintoaineiden saantia. Lopuksi selvitettiin, johtaako hoitajien ja ruokapalveluhenkilöstön ravitsemuskoulutus muutoksiin heidän tiedoissaan sekä ikääntyneiden parempaan ravitsemukseen dementiaosastoilla.

Aineisto ja menetelmät: Vanhainkotiasukkaiden (n=2114) ja sairaalapotilaiden (n=1043) ravitsemustila arvioitiin MNA-testillä (Mini Nutritional Assessment). Lisäksi kyselylomakkeella kerättiin tietoja asukkaiden ja potilaiden ravitsemukseen liittyvistä rutiineista. Dementia- ja demensioasuntojen asukkaiden (n=23; n=21) energian ja ravintoaineiden saanti arvioitiin kolmen päivän ruokapäiväkirjan avulla. Konstruktiivinen oppimisteoria oli hoitajien ja ruokapalveluhenkilöstön (n=28) koulutuksen perustana. Heidän oppimistaan arvioitiin puolistrukturoidulla kyselylomakkeella. Tutkimukset I–IV olivat poikkileikkaustutkimuksia ja tutkimus V interventiotutkimus.

Tulokset: Virhe- ja aliravitsemus oli yleistä vanhainkodeissa ja sairaaloissa. MNA-testin mukaan 11–57 % tutkituista kärsi virhe- tai aliravitsemuksesta ja 40–89 %:lla riski virheravitsemukselle oli kasvanut. Vain 0–16 %:lla ravitsemustila oli hyvä. Dementia, heikentynyt toimintakyky, nielemisvaikeudet ja ummetus pääasiassa selittivät virhe- tai aliravitsemusta. Myös ravitsemushoitoon liittyvät tekijät, kuten vain puolet tai vähemmän tarjotusta ruoka-annoksesta syöminen ja välipalojen syömättömyys olivat yhteydessä virhe- ja aliravitsemukseen. Dementia- ja demensioasuntojen asukkaiden energian ja joidenkin ravintoaineiden saanti oli suosituksia alhaisempaa, vaikka tarjottu ruoka sisälsi riittävästi energiaa ja ravintoaineita. D-vitamiinilisää saavien vanhainkotiasukkaiden osuus oli pieni, vaikka D-vitamiinilisän käytöstä on olemassa suositukset ja sen hyöty on selvästi osoitettu. Hoitajat tunnistivat aliravitsemuksen huonosti, vain neljäsosassa (26,7 %) todetuista tapauksista. Ruokapäiväkirjojen pitäminen ja niiden analysointi sekä ravitsemusasioista keskustelu pienryhmissä olivat hoitajien mielestä tehokkaita oppimistapoja. Ravitsemuskoulutuksella oli positiivinen vaikutus dementiaosastoilla joidenkin asukkaiden energian ja proteiinin saantiin, painoindeksiin ja MNA-testin tulokseen.

Johtopäätökset: Virhe- ja aliravitsemus oli yleistä vanhainkodeissa ja pitkäaikaissairaaoloissa asuvilla ikääntyneillä. Vaikka sairaudet ja heikentynyt toimintakyky pääasiassa selittivät huonoa ravitsemustilaa, hoitajat tunnistivat aliravitsemuksen huonosti ja ravitsemushoidon mahdollisuudet olivat vähäisessä käytössä. Hoito- ja ruokapalveluhenkilökunnan ravitsemuskoulutuksella oli myönteinen vaikutus iäkkäiden dementia- ja demensioasuntojen asukkaiden ravitsemukseen. Lisätutkimukset ravitsemushoidon ja hoitohenkilökunnan ravitsemuskoulutuksen vaikuttavuudesta ovat tarpeen.



1. INTRODUCTION

The number of elderly people worldwide will dramatically increase over the next decades. In 2040 people in Finland over 65 years old will account for more than one quarter of the whole population. At the same time the oldest cohort (over 85 years) is increasing in numbers most rapidly (Statistics Finland).

Biological aging and disablement processes occur continuously and varies between individuals. Many factors affect individual aging and there is a large heterogeneity between individuals. Social, economic, physiological and psychological changes with aging have effects on eating patterns and nutritional status. On the other hand, the diet has an influence on the aging process as well (Solomons, 2000).

The increasing number of elderly people is leading to an increased demand on health care. Aged individuals are: often vulnerable to many illnesses, they are frail, and they have disabilities in self-care tasks (Fried et al, 2004). The role of nutrition in the maintenance of aged individuals' health, management of chronic conditions, treatment of serious illnesses, and rehabilitation of functional limitations has risen to the top of the agenda for public interest and research during the last decades (Nagi, 1976; Fiatarone et al, 1994; Fried et al, 2004; Vellas et al, 2006).

Good nutrition and physical activity are health-promoting lifestyle approaches in the elderly population. An inadequate nutrition contributes to sarcopenia, frailty, loss of functions and the progression of diseases in elderly people (Morley, 2001a). Nutritional status is influenced by medical, physiological, psychological and social variables. Encouraging better nutrition and physical exercise is a cost-effective way of decreasing progression of age-related diseases (Fiatarone et al, 1994; Morley, 2001b). As people age, adequate nutrition promotes the maintenance of health, physical performance and psycho-social well-being (Bates et al, 2002; Nijs et al, 2006ab).

Malnutrition has been recognized as a common problem among aged residents living in institutional care facilities (Lauque et al, 2000; Saletti et al, 2000). Malnutrition is associated with certain diseases and impaired functioning, but less is known about its relationship with nutrition intake and nutritional care among aged residents (Milne et al, 2006). The assessment of the nutritional status of elderly people should be part of their care (Cowan et al, 2004). There are many tools for identifying the nutritional risks, but the most extensively evaluated tool is the Mini Nutritional Assessment -test (MNA) according to Green and Watson (2006).

Nutritional advice for elderly residents and patients should focus on weight maintenance (Morley, 2001b). Not all elderly individuals are the same with regard to appropriate nutritional interventions, however. The intervention for healthy elderly people should differ from those who are frail, from those with dementia, and from those who are at the end of their lives (Morley and Flaherty, 2002).

Nutritional treatment when carried out early enough seems to have a positive effect on energy and nutrient intake in frail elderly people (Milne et al, 2006). It can produce weight gain and increase physical activity (Morley, 2003). Oral nutritional supplements (ONS) have usually been the primary intervention when treating malnutrition (Lauque et al, 2004; Young et al, 2004). Studies with enriched food have also had positive outcomes in the energy intake of elderly hospital patients (Barton et al, 2000a; Christenson et al, 2001). Collective mealtimes in nursing homes and long term care hospitals provide an opportunity to integrate and implement good nutritional care. A pleasant and social environment during mealtimes may add a sense of security and satisfaction with life (Nijs et al, 2006a).

In this study: the nutritional status, the energy and nutrient intake, factors related to nutritional care, and nutritional care options to support nutrition in elderly individuals who lived in institutional care settings in Finland were investigated.

2. LITERATURE REVIEW

2.1 DIET IN ELDERLY POPULATIONS

Diet and lifestyle over a whole life influence morbidity and mortality. Because of the cumulative effect of adverse factors, it is particularly important for aged people to adopt a diet and lifestyle habits that minimize the risk of morbidity and maximize the prospects for healthy aging (WHO, 2002). Food habits in aged people are not only influenced by the lifetime preferences and by physiological changes according to aging but also by social aspects such as loneliness, economic situations or conditions and disability. The quality of diet is often poor among people 85 years and older (Wakimoto and Block, 2001).

Mealtime patterns and dietary intake vary across the world, but the most significant change in the oldest age groups compared to younger cohorts is an overall decrease in energy intake and concurrent decreases in macronutrient intake (Wakimoto and Block, 2001; de Groot et al, 2004). Moreover, micronutrient intakes decrease after the age of 50, reaching its lowest point in the oldest age groups (Wakimoto and Block, 2001). There are also changes in patterns of diet composition and a reduction in the variety of foods consumed in the elderly population that further reduces the energy intake (Roberts and Rosenberg, 2006).

The Survey in Europe on Nutrition and the Elderly (SENECA) originally, which was carried out in 13 towns of 12 countries in the years 1988–1989, 1993 and 1999 concluded that a healthy lifestyle among the elderly people was related to a delay in the deterioration of health status and to a reduced mortality risk. Elderly people's inactivity and smoking increased the mortality risk (de Groot et al, 2004). According to the SENECA study the energy intake among 70-year olds is at the level of recommended intake, but decreases ca 20% between the ages 70 and 80 (Moreiras et al, 1996). No single criterion for energy intake has been found that ensures an adequate micronutrient supply, but adequate nutrient intake was always found in those people with high-energy intakes (Schroll et al, 1996). The prevalence of an inadequate intake of one or more micronutrients was high, being 47% in elderly women and 24% in elderly men (de Groot et al, 1999).

The FINE (Finland, Italy the Netherlands) study consists of the survivors of 5 cohorts of the Seven Countries Study. The study ran from 1984 to 2000, and recruited men who were born between 1900 and 1920. The response rates in 1989 to 1991 were 92% for the Finnish cohorts, 74% for the Dutch cohort, and 76% for the Italian cohorts. In elderly men (65 to 84 years) ten years death rates from all causes were highest in Finland. Smoking habits and heart rate were consistently associated with all-cause mortality (Menotti et al, 2001). Comparing to the dietary intake at middle age, the dietary pattern of the Finnish and Dutch cohorts had changed to direction towards a healthy diet (Huijbregts et al, 1995).

The HALE project included participants of the SENECA and FINE studies who were examined in 1988–1991 and were followed up for 10 years (Knoops et al, 2004). Predictors of lower rates of mortality among elderly aged 70 to 90 were adherence to a healthy lifestyle and to a Mediterranean diet, including 8 components, such as the type of consumed fat; legumes, nuts and seeds; grains; fruit, vegetables and potatoes, meat; dairy products; and fish (Knoops et al, 2004).

In a healthy elderly US population (71 to 85 years) the dietary fat and protein proportions were reported to be above the estimated average requirements (EAR). However, dietary vitamin D, vitamin E, folate and calcium intakes were below EAR even after including additional amounts of supplements. More than 30% of the men and over half of the women had reported daily energy intakes of less than 1600 kcal (Foote et al, 2000).

2.2 VITAMIN D

2.2.1 Vitamin D and the risk of fractures in the elderly

There has been a great interest in reporting vitamin D status related to various disorders specifically in aged populations (Heaney, 2006). Elderly people are at risk of having an inadequate vitamin D status especially in the wintertime, and vitamin D supplementation has also been recommended to elderly people (de Groot et al, 2004; National Nutrition Council, 2005).

It has been shown that vitamin D and calcium supplementation decrease the incidence of fractures by 20 to 30% (Chapuy et al, 1992; Chapuy et al, 1994; Dawson-Hughes et al, 1997; Pfeiffer et al, 2000; Trivedi et al, 2003; Bischoff-Ferrari et al, 2005) and therefore it may also decrease the overall health care costs (Trivedi et al, 2003). Vitamin D has its effect on bone mineral density (Sairanen et al, 2000; Lips, 2001; Tuck and Francis, 2002; Bischoff et al, 2003), but also on the skeletal muscles by improving their function (Bischoff et al, 2003; Venning, 2005). The dose of vitamin D effectively decreasing fractures seems to be at least 17.5–20 µg (700–800 IU) per day (Venning, 2005).

2.2.2 Vitamin D supplementation in institutions

The risk of nursing home admission in community-dwelling persons aged 65 years or more have been inversely related to the vitamin D status (Visser et al, 2006). Elderly people who live in institutions should receive enough supplemental vitamin D since their diets often provide less than the recommended amounts of vitamin D (Lips et al, 1987). The dosage of vitamin D supplementation among nursing home residents varies from 5 µg to 20 µg (Gupta and Aronow, 2003). Vitamin D supplements have been prescribed only to 32% (Gupta and Aronow, 2003) and 9% (Kamel, 2004) of elderly nursing home residents.

2.3 NUTRITION STUDIES OF FINNISH ELDERLY PEOPLE

The first study concerning elderly Finnish people's nutrition was performed in 1955 (Karvetti 1958). The nutrition of married couples and the elderly living in the country side was better than single males and people living in towns. In 1986 to 1987 food consumption, nutritional status and health status of elderly people living at home and in old people's homes were investigated in South Western Finland (Rajala, 1991). The prevalence of malnutrition was 15% in old people's homes and 2 to 5% among the elderly people who lived at home. The energy intake of people living in old people's homes was 30% less than that of people living at home. The intakes of vitamin D, E, and folic acid were low, and many of the studied elderly had low serum 25(OH)-D3 vitamin concentrations. The nutrition studies of elderly Finnish people published up to the year 1989 have been reviewed by Rajala (1991).

The diets of 70 to 89 -year old Finnish men were studied as a part of the Seven Countries Study in 1989. The average energy intake was 2700 kcal, and the proportion of fat in the total energy intake was high, but the diet was comparable to that of younger people (Rasanen et al, 1992). As a part of Finriski and Finravinto studies the energy intake of 65 to 75 -year old Finnish people living at home was studied. The energy intake of females was on average 1448 kcal/day and that of males 1971 kcal/day. The intake of most nutrients was near the recommendations (Korpela et al, 1999). Those with higher education had healthier food consumption habits compared to those with lower education levels (Sulander et al, 2006).

The nutritional status of elderly people who were acutely hospitalized (Laakkonen et al, 1991) or who lived at home (Rissanen et al, 1996) was studied by collecting dietary, anthropometric, biochemical and haematological data in 1986. The nutritional status of people over 70 years of age and who lived at home was good. Chronic diseases affected the energy intake in males but not in females (Rissanen et al, 1996). In hospitalized patients malnutrition was common: 24% of the patients in acute care, and after one year follow-up 36% of them still had malnutrition (Laakkonen et al, 1991).

2.4 NUTRITION OF ELDERLY SUBJECTS IN INSTITUTIONS

2.4.1 Energy and nutrient intake

Energy intake of institutionalized elderly people varies, but inadequate energy intake is common (Eastwood et al, 2002). The mean energy intake of nursing home residents was reported to be 1 476 kcal/d in females, and 1 764 kcal/d in males (Lammes and Akner, 2006), and among residents with Alzheimer's disease (AD) 1 247 kcal/d (Young and Greenwood, 2001). In another study, the mean energy intake of AD patients who lived in institutions was 1 552 kcal/d and with ONS 1 707 kcal/d (Parrot et al, 2006). Among institutionalized aged women (72 to 98 years) the mean energy intake was 1597 kcal/d, and it was concluded that an inadequate intake of micronutrients might have contributed to the malnutrition of these aged women (Ruiz-Lopez et al, 2003). In one study the energy intake of patients with hip fractures was low, only 900 to 1 100 kcal (Delmi et al, 1990; Eneroth et al, 2005). In the study of Wendland and co-workers (2003) cognitively impaired residents' average daily energy intake ranged between 1 000 and 1 500 kcal/d, and the intakes of micronutrients were less than those recommended. In another study the intake of micronutrients was 40 to 90% below the recommended level for nursing home residents (Schmid et al, 2003).

Elderly patients were reported to have an average intake of energy of less than 50% of their calculated requirements when they stayed in hospital. Similarly, residents who skipped meals had a lower BMI, and energy and protein intake than the other residents (Sullivan et al, 1999; Beck and Ovesen, 2004). Among demented subjects impaired cognition is associated with impaired food intake early in the course of the disease (Cronin-Stubbs et al, 1997). The lack of help in eating has been the risk factor for the low intake of energy and protein (Schmid et al, 2003). The intake of micronutrients has also been low because the residents ate foods of a low nutrient density (Schmid et al, 2003). A highly varied diet has been associated with better nutritional status in elderly nursing home residents (Bernstein et al, 2002).

2.4.2 Meals in institutions

Although hospital menus provide enough energy and other nutrients, the food wastage (> 40%), results in energy and protein intakes less than 80% of that recommended intake level (Barton et al, 2000b). Elderly patients did not receive enough assistance during mealtimes, and about one-third of these patients left more than two-thirds of their meals uneaten (Xia and McCutcheon, 2006). Another study showed that hospitalised patients did not eat as much as has been planned and their needs for energy and nutrients were not been met (Dupertuis et al, 2003).

According to Morley (2001b) too large servings of meals may decrease the total amount of food eaten by the resident. On the other hand, the combination of enriched food and small food portions has had a positive association on the intake of energy for elderly patients (Barton et al, 2000a; Lorefält et al, 2005). It has been reported that meals high in carbohydrates resulted in an increase in the mean energy intake of elderly nursing home residents with AD (Young et al, 2005). Similarly, meals based on individual nutritional requirements and resident's problems, desires and resources, increased energy intake of residents (Christensson et al, 2001). Changes in the menu and the dietician consultation time promote weight gain in long-term care facilities (Keller et al, 2003). The change in the food delivery system from a preplating service to a more homelike service has been reported to result in a significant increase in food intake of nursing home residents (Hotaling, 1990; Nijs et al, 2006ab).

2.5 NUTRITION GUIDELINES AND RECOMMENDATIONS FOR ELDERLY PEOPLE

The need for energy declines with advancing age but the need for nutrients is the same or even greater than that required by younger people. According to the American Dietetic Association (ADA) the nutrient requirements of elderly people are not fully understood, although it is known that the physiological and functional changes that occur with aging can result in changes in nutrient needs (ADA Reports, 2005). In addition, those elderly people who have low food intakes may need specific nutrient recommendations (Bates et al, 2002; Wenland et al, 2003). Because of the declining need for energy in aging people, the intakes of protein and micronutrients also decrease, and the quality of diet is difficult to maintain. Dietary guidelines for elderly people should emphasize nutrient-dense foods (Blumberg, 1997; Foote et al, 2000). The Dietary Reference Intakes (DRI; Food and Nutrition Board, 2002) provide a set of reference values for people over 70 years of age. The DRI may be used in assessing the nutrient intake and planning the diets of elderly residents (ADA Reports, 2005).

Current American DRI (Food and Nutrition Board, 2002) for energy for people over 70 years of age is 1564 to 2238 kcal/day. According to the Finnish National Nutrition Council (2005), the reference value for energy requirement for females over 75 years with low or moderate physical activity is 1700 to 1970 kcal (7.1 to 8.2 MJ)/day and for males 2010 to 2300 kcal (8.4 to 9.6 MJ)/day (Table1). These reference values are suitable only for the assessment of group levels, not for individuals (National Nutrition Council, 2005). The recommendations of the National Nutrition Council are based on the Nordic Nutrition Recommendations (Nordic Council of Ministers, 2004).

Finnish Current Care guidelines for osteoporosis prevention recommend 17.5 to 20 µg (700 to 800 International Unit, IU)/d of vitamin D for all institutionalized elderly people all year around (Finnish Endocrinological Society, 2006). According to the Finnish Nutrition Recommendations (National Nutrition Council, 2005), the reference value for vitamin D supplementation for people over 60 years is 10 µg (400 IU)/d during wintertime, as well as for those who stay indoors throughout the year.

Table 1. **Dietary reference intakes for elderly people in Finland and the USA.**

Age, years	Units per day	2005 Finland ¹⁾	2002 USA, DRI ²⁾
		75+	71+
Energy, F/M ³⁾	Kcal/MJ	1 700/2 010 7.1/8.4	1 564/2 238
Protein	% of energy	15–20 ⁴⁾	
Fat	% of energy	25–35	20–35
Vitamin A, F/M	RE ⁵⁾	700/900	700/900
Vitamin D	µg	10	10
Vitamin E, F/M	mg	8/10	15
Thiamin, F/M	mg	1.0/1.2	1.1/1.2
Riboflavin, F/M	mg	1.2/1.3	1.1/1.3
Vitamin B12	µg	2.0	2.4
Folic acid	µg	300	400
Vitamin C, F/M	mg	75	75/90
Calcium	mg	800	1 200
Zinc F/M	mg	7/9	8/11
Selenium, F/M	µg	40/50	55
Iron	mg	9	8

¹⁾ Finnish Nutrition Recommendations (National Nutrition Council, 2005),

²⁾ Current American DRI (Food and Nutrition Board, 2002),

³⁾ F=females, M=males,

⁴⁾ when the intake of energy is low (<6.5 MJ/d),

⁵⁾ retinolequivalent

2.6 PHYSIOLOGICAL CHANGES RELATED TO THE NUTRITION AND AGE

2.6.1 Reasons behind the negative energy balance of elderly individuals

The early phase of aging (55 to 65 years) is often associated with a positive energy balance and an increase in body fat which is associated with excess morbidity, mortality, and health care costs (Cornori–Huntley et al, 1991; Andreyeva et al, 2004; Calle et al, 2005). In the subsequent phase of aging (after 65 to 75 years) body fat and lean body mass decrease and continue to decline with a negative energy balance (Wilson and Morley, 2003). Protein-energy malnutrition is very common in the oldest age group (Morley, 1997).

It is difficult to identify which age-related dysfunctions are responsible for causing negative energy balance in elderly people (Morley, 2006). Food intake decreases by 20% between the ages 70 and 80 (Moreiras et al, 1996). Both physiological and non-physiological factors cause the decline in food intake among elderly people (Hays and Roberts, 2006). Physiological factors include neural, hormonal, and metabolic mechanisms (Morley, 2006; Hays and Roberts, 2006). Non-physiological causes of weight loss include social, psychological, medical and pharmacological factors (Table 2). Frailty in elderly people is often accompanied by weight loss and/or malnourishment (Fried et al, 2001). The absorption rate of macronutrients may be delayed and a number of hormonal and metabolic mediators of energy regulation change with aging (Roberts and Rosenberg, 2006). The changes in endocrine function have an influence on nutrient requirements and nutritional status. The nutritional status for its part influences glandular activities (Morley, 2006). It has also been suggested that dementia patients have higher energy requirements (Wolf-Klein et al, 1995) than healthy individuals, but no evidence for this has been found (Donaldson et al, 1996; Poehlman et al, 1997; Mazzali et al, 2002).

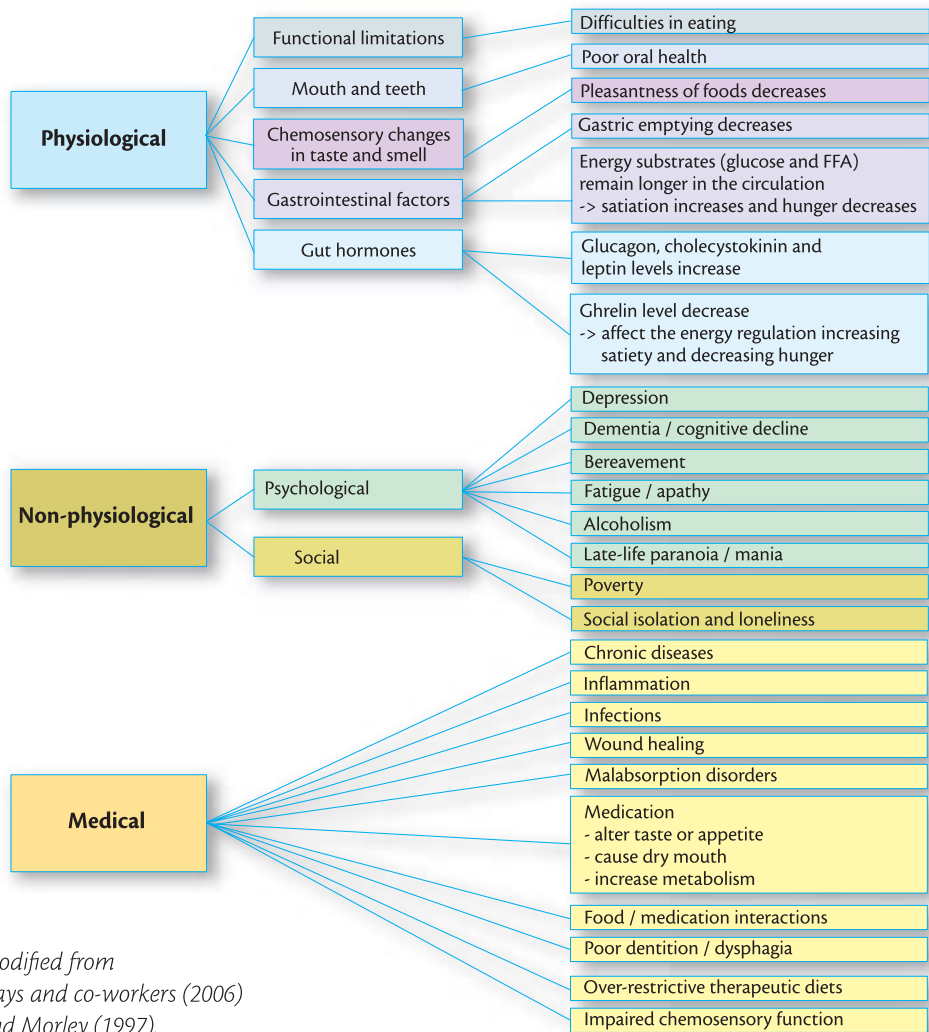
Total energy expenditure (TEE) and physical activity level (PAL) decline through adult life in men and women. In normal weight individuals daily TEE falls by 150 kcal every decade, and PAL from an average of 1.75 on the second decade of life to 1.28 in the ninth decade (Roberts and Dallal, 2005). The resting metabolic rate (RMR) is reduced in elderly people by between 10 to 20%, which has been thought to manifest in the reduced lean body mass (Lipson and Bray, 1986; Lammes and Akner, 2006). RMR among chronically diseased elderly nursing home residents measured by indirect calorimetry was found to be 1 174 kcal/d (29.3 kcal/kg FFM/d). Mean energy intake of these residents was 1474 kcal/d and the energy intake/RMR ratio was 1.27 (Lammes and Akner, 2006). In females the decline in RMR is smaller than in males. The metabolic causes for age-dependent changes in body composition had not been clearly identified (Evans, 1986). The changes in the activities of growth hormone and testosterone may contribute to the shift in balance from lean to adipose tissue. The decreased capacity in muscle fibre regeneration has also been suggested (Evans, 1986).

The ability of aged individuals to regulate energy intake is impaired (Roberts and Rosenberg, 2006). If elderly individuals are underfed for longer periods of time they fail to return to normal body weight again, whereas younger individuals are able to return their baseline body weights (Roberts et al, 1994). The ability to increase or decrease energy expenditure in order to attenuate energy imbalance during overeating or undereating decreases (Roberts and Rosenberg, 2006).

Early satiation in older compared to younger individuals is a result of the gastrointestinal factors (Morley, 2001c). Large meals reduce the rate of gastric emptying in elderly persons compared to younger individuals (Clarkston et al, 1997). The result is more rapid satiation because of the reduction in the ability of the fundus of the stomach of the elderly to adaptively relax (Morley and Thomas, 1999). Because of the subjective sensation of satiety, elderly men (aged 60 to 84 years) consume significantly less energy than younger men (aged 18 to 35 years). Moreover, the energy regulation among elderly men is impaired compared to the younger individuals (Rolls et al, 1995).

It has been suggested that changes of taste thresholds and decreasing of olfaction lead to decreased food intake in the elderly (Rolls, 1999). In addition, the loss of natural teeth, chewing problems, and poor oral health are predictors for the risk of malnutrition (Hildebrandt et al, 1997; Lamy et al, 1999; Gnep et al, 2000; Allen, 2005; Soini et al, 2006).

Table 2. Possible causes of weight loss in elderly people.



Modified from
Hays and co-workers (2006)
and Morley (1997).

2.6.2 Body mass index and weight loss

Low body mass index (BMI) is associated with increased mortality among aged people (Dey et al, 2001; Tayback et al, 1990). A BMI of less than 20 kg/m² is an independent predictive factor of short-term mortality in the elderly population (Sergi et al, 2005). Those elderly people who have stable weight have the lowest mortality (Sullivan et al, 2004). Even a small decline in body weight, rather than weight gain, is an important and independent risk factor of mortality in elderly people age 65 years or more (Newman et al, 2001). However, elderly individuals with low body weight are a heterogeneous group including those who have always been active and lean, and those who have lost weight as a result of poor health (Willet, 1997).

The optimum BMI may be higher for elderly people compared with young and middle-aged population, and weight reduction among mild or moderately overweight elderly people may be not advisable (Heiat, 2003). During a 15 years follow-up study on elderly people between 70 to 85 years the lowest mortality ranges were found to be 24.7 to 26.4 kg/m² in males, and 24.6 to 26.5 kg/m² in females (Dey et al, 2001). New, age-specific standards and guidelines of ideal weight have been suggested (Heiat et al, 2001; Heiat, 2003).

Low BMI and unintentional weight loss are common and underrecognized problems among elderly individuals with several illnesses, cognitive and functional disabilities and among those who live in institutions (McWhirter and Pennington, 1994; Kelly et al, 2000; Saletti et al, 2000; Dey et al, 2001; Mamhidir et al, 2006; Gillette-Guyonnet et al, 2007). Low BMI associated with an increased death rate is common in old patients (Landi et al, 2000). Moreover, BMI less than 22 kg/m² is associated with a decreased functional status and psychosocial well-being in nursing home residents, aged 65 years or older (Crogan and Pasvogel, 2003). Among elderly patients (80±7 years) with dementia, a BMI of less than 23 has been associated with an increased risk for 7-year-mortality (Faxen-Irving et al, 2005). Risk factors associated with underweight and weight loss are cognitive and functional decline. Dementia and Parkinson's disease, eating dependencies and constipation are the strongest risk factors (Mamhidir et al, 2006).

A criterion BMI less than 24 kg/m² or any degree of weight loss has been suggested as a simple screening criterion for identifying those elderly patients who may benefit from nutritional intervention treatment (Beck and Ovesen, 1998). In feedback from dieticians, BMI alone is of limited use and the reference range (20–25 kg/m²) has not been appropriate for older subjects in identifying those at risk for nutritional problems (Cook et al, 2005).

2.6.3 Obesity

Obesity-related excess on mortality in elderly people is different from younger individuals and declines with age at all levels of obesity (Bender et al, 1999). However, there is an increased risk of functional limitations among the surviving women with very high BMI (>35 kg/m²) (Tayback et al, 1990). Although weight gain causes an increase in lean and fat body mass, obesity acts synergistically with sarcopenia causing disability in the elderly people partly because of the low muscle quality (Villareal et al, 2004). It has been suggested that sarcopenic obesity should be considered a significant health problem among elderly individuals (Villareal et al, 2004).

According to the Finriski 1997 and Health 2000 -study, obesity (BMI>30) was not as common in the oldest age group (85+ year) as among people 65 to 74 -years of age. The mean BMI among 65 to 74 year old males was 27.6 and among females 28.2 (Korpela et al, 1999), and 22.7% of males, and 33.5% of females of the same age group were obese (BMI>30), whereas in people 85 years and older only 11.3% of males and 14.5% of females were obese (Health, 2000).

2.7 NUTRITIONAL ASSESSMENT OF ELDERLY PEOPLE

The full assessment of elderly people's nutritional status includes several biochemical and anthropometric measurements, but it is not a practical or cost-effective way to assess a large number of elderly people's nutritional status (Reynish and Vellas, 2001). The screening of the nutritional status is a rapid and simple process performed by admission staff or health care teams, whereas the nutritional assessment is a detailed examination including several measures of metabolic, nutritional or functional variables performed by an expert clinician, nutrition nurse or dietitian (Kondrup et al, 2003).

Several risk factors have been used in nutritional assessment tools, ranging from subjective assessment to objective measurements (Green and Watson, 2006). More focus should be given to individualized nutritional assessment in order to discover the cause of any reduced energy and protein intake of elderly residents (Beck and Ovesen, 2004). Nutritional status of all elderly patients should be assessed as a part of their care (Edington et al, 2004). Simple measures such as monitoring an elderly individual's weight regularly need to be implemented as a surveillance measure of nutritional status (Cowan et al, 2004). The calculation of BMI doesn't provide any information about body composition, however (Sieber, 2006).

2.7.1 Tools for nutritional assessment

In recent years a number of instruments have been developed in order to screen and assess aged people's nutritional status or to identify those at risk of malnutrition (Cook et al, 2005). In a review by Green and Watson (2006), 21 nutritional designated tools were identified for use on aged individuals (Green and Watson, 2006). There has been much effort and time spent on developing these tools, but according to Jones (2002) none of the tools have been published with sufficient information on their applications, development and evaluation. Because of the widespread neglect of nutritional problems in health institutions ESPEN (European Society of Parenteral and Enteral Nutrition) has considered the predictive validity of the generally accepted screening tools to be sufficient and have given recommendations for different age groups (Kondrup et al, 2003). According to Green and Watson (2006) the most extensively evaluated tool is the Mini Nutritional Assessment (MNA).

2.7.2 Mini Nutritional Assessment

The development of the MNA began in the meeting of the International Association of Geriatrics and Gerontology (IAG) in 1989 (Vellas et al, 2006). The widely used MNA test was developed and validated in France and United States for the nutritional assessment of elderly, frail patients (Vellas et al, 1999; Vellas et al, 2000; Guigoz et al, 2002). The first publication of the MNA appeared in 1994 (Guigoz et al, 1994).

The MNA is a simple, reliable, well-validated scale and it demonstrates good sensitivity compared to a variety of nutritional parameters, such as biochemical, anthropometry, or dietary intakes (Bleda et al, 2002; Guigoz et al, 2002; Guigoz, 2006). The MNA does not involve laboratory analyses and it is also suitable for systematic and large studies (Compan et al, 1999). However, the MNA is only a part of the comprehensive geriatric assessment (CGA) and no nutritional intervention should be based only on the MNA because the geriatric population is too heterogeneous to establish rules that apply to all (Vellas et al, 2006).

The full MNA includes 18 different variables in four main areas: anthropometric measurements (BMI, weight loss, arm and calf circumferences), general assessment (lifestyle, medication, mobility and presence of signs of depression or dementia), short dietary assessment (number of meals, food and fluid intake, and autonomy of feeling), and subjective assessment (self perception of health and nutrition) (Guigoz, 2006). A description of the MNA can be found at the website <http://www.mna-elderly.com/clinical-practice.htm> (Appendix 1). Nutritional status by the MNA can be assessed using a 2-step process, starting with the MNA-SF (MNA-Short Form) and if necessary proceeding with the complete version of the MNA, which can be performed in less than 15 minutes (Vellas et al, 2006). The MNA gives a maximum of 30 points and it is able to classify an elderly individual as well nourished (>23.5 points), at risk for malnutrition (17-23.5 points) and malnourished (<17 points) (Vellas et al, 1999; Guigoz et al, 2002; Vellas et al, 2006).

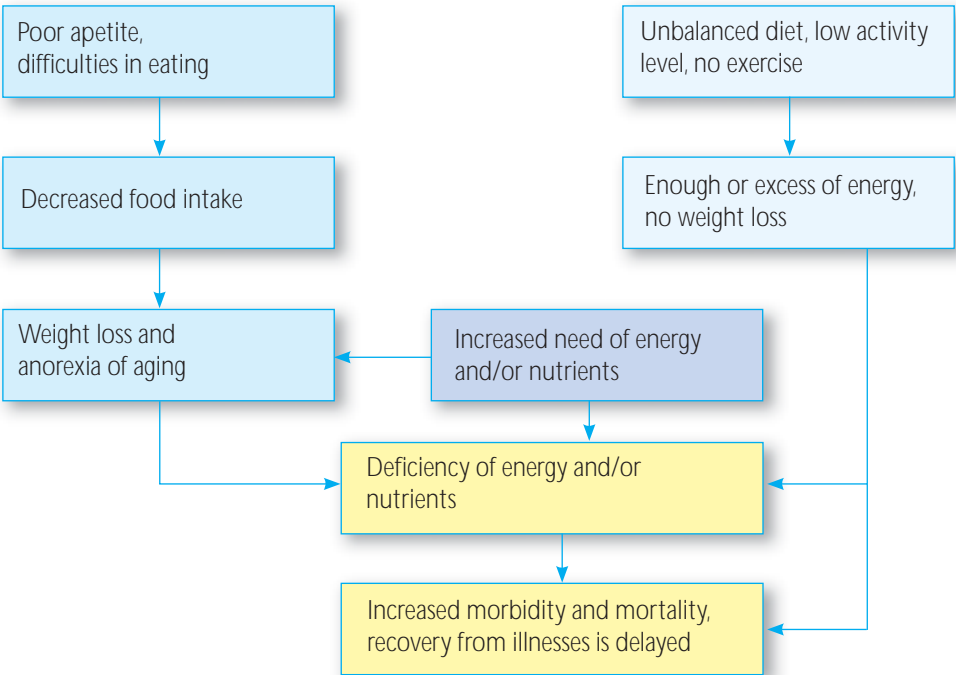
One of the advantages of the MNA is that it aims at identifying elderly people who are at risk of malnutrition, thus providing an opportunity for prevention (Christensson et al, 2002) and intervention (Vellas et al, 2006). Nutritional interventions should be specifically targeted to those areas where the elderly persons have scored low points in the MNA evaluation. The comprehensive nature of the MNA gives professionals who take care of these elderly, a unique opportunity to design specific care plans for nutritional intervention (Vellas et al, 2006). The MNA is widely used and includes items for functionality and body composition (Sieber, 2006).

For healthy elderly individuals, nutritional assessment by the MNA is of limited value (de Groot et al, 1998) although it comprehensively covers the factors affecting elderly world in the community, in a long term care setting and in acute care facilities (Sieber, 2006). A drawback of the MNA is that patients with dementia are not able to answer some of the questions themselves and proxies have to answer these questions on their behalf. In addition, the MNA cannot be used in patients receiving enteral nutrition such as percutaneous endoscopic gastronomy (PEG) (Sieber, 2006).

2.8 MALNUTRITION IN ELDERLY PEOPLE

Malnutrition has been defined as the state of being poorly nourished. It may be caused by the lack of energy and/or nutrients, or by an excess of energy and/or nutrients (Hickson, 2006). Protein-energy malnutrition (PEM) develops when the diet doesn't satisfy the body's needs for protein, energy, or both including a wide variety of clinical manifestations. Its severity ranges from weight loss to clinical syndromes associated with deficiencies of nutrients. The origin of PEM can be primary or secondary. Primary PEM is the result of insufficient food intake, and secondary PEM the result of a disease (Figure 1).

Figure 1. **Paths leading to malnutrition among elderly people.**



Malnutrition appears to be a major contributing factor for a poor prognosis in elderly persons (Flodin et al, 2000; de Groot et al, 2002). Malnutrition in aged individuals normally occurs as three different conditions termed: anorexia, sarcopenia, and cachexia. The loss of appetite and physiological decline and lower food intake lead to involuntary weight loss and is called anorexia of aging (Morley, 2001a). Sarcopenia is a loss of muscle mass and strength due to diminished physical activity and/or protein malnutrition. Cachexia is characterized by increased cytokine production that may lead to catabolism and loss of both fat and muscle mass, that plays a role in the development of age-related sarcopenia (Roubenoff et al, 1997; Morley, 2001a; Morley et al, 2006; Sieber, 2006).

Aging is associated with the depletion of fat free mass (FFM) starting at an age of about 45 years (Vandervoort, 2002). Sarcopenia and body shape changes can be understood as a part of the normal aging process, where the balanced and adequate diet and physical exercise seem to be the best preventive strategies (Roubenoff, 2000). When sarcopenia reaches a stage where it interferes elderly person's ability to perform daily activities, it becomes a clear problem both for obese and non-obese elderly people (Gallagher et al, 2000; Janssen, 2006). It is not easy to recognize malnutrition and sarcopenia among elderly individuals who have retained their fat mass. Malnutrition, obesity and frailty are often interlinked among old people known as "fat frail" (Morley, 2001c; Roubenhoff, 2004; Villareal et al, 2004), which can be ameliorated with weight loss and exercise in obese older adults (Villareal et al, 2006). Although the risks for malnutrition are associated with the risks of weight loss (Table 2, page 20), it is also important to identify malnutrition in elderly individuals with normal or high BMI.

2.8.1 The risk for malnutrition

The risk for malnutrition increases with age and with a weakening of functional capabilities. Immobility is a major risk factor for the development of malnutrition (Schmid et al, 2003). Those elderly people who are dependent on other people's help, who have impaired ADL skills and mobility are specially at high risk of malnutrition (Saletti et al, 2000; Lauque et al, 2000; Wissing et al, 2001; Gerber et al, 2003). Malnutrition, low body-mass index (BMI) and unintentional weight loss have negative impacts on the functional status and psychosocial well-being of elderly individuals and they are also risk factors for increased mortality (Takala et al, 1994; Dey et al, 2001; Crocan and Pasvogel, 2003). Malnutrition has been associated with increased in-hospital mortality, a higher rate of admission to nursing homes, and a longer length of stay in hospitals (Van Nes et al, 2001).

Malnutrition is associated with many syndromes and clinical problems such as dementia, depression, pressure ulcers, stroke, falls, and hip fractures (Compan et al, 1999; Milne et al, 2006). Several other illnesses and conditions are known to increase the risk of malnutrition, such as Parkinson's disease, diseases of the mouth and throat, chewing problems, eating dependency, being bedfast, female gender, and age 85 or older (Blaum et al, 1995; Hildebrandt et al, 1997; Lamy et al, 1999; Wells et al, 2003). Behavioral disturbances in dementia, such as aversive eating behavior and restlessness are associated with malnutrition in AD (Blandford et al, 1998; White et al, 2004).

Weight loss and malnutrition should be considered an adverse health indicator (Sahyoun et al, 2004). Weight loss was a frequent complication among 40% of patients with dementia, in the early stages and even before diagnosis (Wallace et al, 1995). Malnutrition impairs the functional capabilities of elderly patients suffering from dementia (Magri et al, 2003). Malnutrition also impairs immune responses thus it indirectly exposes elderly people to infections and bed sores (Lesourd, 1997). Elderly residents' malnutrition is often unrecognized and there is a lack of documentation on the nutritional deficiencies in nursing homes (Abbasi and Rudman, 1993).

A knowledge of nutritional status of aged people in care is far from complete. There is a need for further research that would increase the understanding of the factors that contribute to malnutrition in order to develop appropriate prevention strategies and treatments for unintentional weight loss and malnutrition in aged people (Thompson Martin et al, 2006). It is also important to distinguish between unintentional and intentional weight loss and to determine the extent of weight loss that is consequential to clinical outcomes in elderly people (Thompson Martin et al, 2006). Assessment is the way to guarantee that nutritional interventions are started early enough. It is crucial to have assessment tools that can identify those elderly individuals who are at risk or suffer from malnutrition (Sieber, 2006). Malnutrition is usually underdiagnosed and undertreated even though nutrition treatment seems to have a positive discernable effect on energy intake and weight gain as well as physical activity among aged patients (Akner and Cederholm, 2001; Morley, 2003; Milne et al, 2006).

2.8.2 The prevalence of malnutrition

For more than 2 decades ago the link between malnutrition, weight loss, and low energy intake have been recognised as common problems among elderly residents living in institutions (Shaver et al, 1980). Many studies have since verified this finding (Rudman and Feller, 1989; Abbasi and Rudman, 1993; Abbasi and Rudman, 1994; Thomas, 1997; Lauque et al, 2000; Saletti et al, 2000;

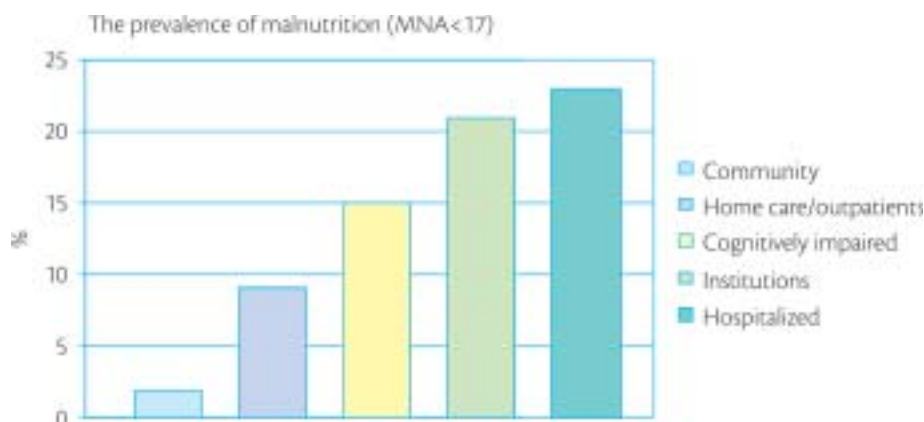
Van Nes et al, 2001; Christensson et al, 2002; Gerber et al, 2003). Although the prevalence of actual malnutrition is low in healthy elderly persons, the risk of malnutrition is relatively high (de Groot et al, 2002; Guigoz, 2006), which points out the importance of monitoring nutritional status in all groups of elderly people (de Groot et al, 2002).

The MNA has been used to assess ~35 000 aged people's (>65 years) nutritional status in 127 published studies in various settings (Guigoz, 2006) (Table 3). Among community-dwelling elderly people the prevalence of malnutrition has been only 2%, but in hospitalized and institutionalized elderly people it has been 23% and 21% respectively (Figure 2). The risk of malnutrition is higher and more widespread. Among elderly living in a community it can be 24% and in hospitalized and institutionalized elderly people 46% and 51% respectively. There is a wide variation in the prevalence of malnutrition of institutionalized elderly people. In cognitively impaired elderly persons the prevalence of malnutrition was 15% (Guigoz, 2006). In Sweden one in two of aged residents of old people's homes were at risk of malnutrition and one in three were actually malnourished (Saletti et al, 2000).

Table 3. **The description of the use and results of the MNA in the studies of community-dwelling, frail, hospitalized, institutionalized and cognitively impaired elderly subjects (Guigoz, 2006).**

	The number of studies using the MNA	The number of assessed elderly subjects	The results of the MNA, % (range)		
			<17 Suffers from malnutrition	17–23.5 In the risk of malnutrition	>23.5 Good nutritional status
Community-dwelling elderly	23	14 149	2 (0–8)	24 (8–76)	74 (16–100)
Frail elderly	25	3 119	9 (0–30)	45 (8–65)	50 (11–91)
Hospitalized elderly	36	8 596	23 (1–74)	46 (8–63)	31.5 (6–68)
Institutionalized elderly	32	6 821	21 (5–71)	51 (27–70)	29 (4–61)
Cognitively impaired elderly	11	2 051	15 (0–62)	44 (19–87)	41 (0–80)

Figure 2. **The prevalence of malnutrition (% of elderly individuals) by the MNA in different categories in aged populations, (n ~35,000 elderly individuals).**



Modified from Guigoz (2006).

2.8.3 Finnish studies using the MNA

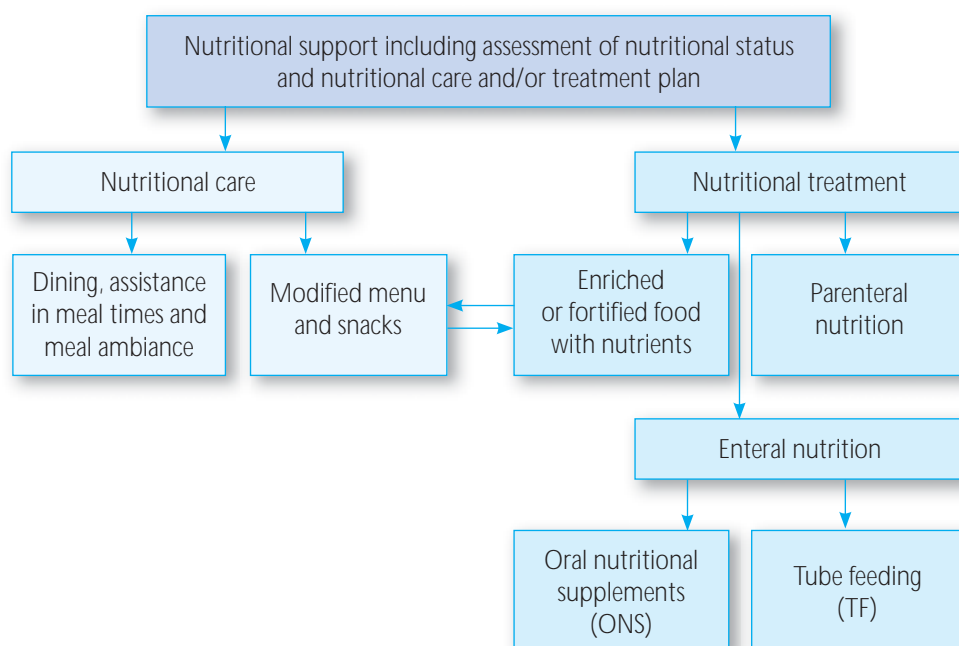
The nutritional status of people aged 75 or more (n=91) and who lived in institutions in Finland was studied in 1999 using the MNA. More than one fourth of those elderly individuals suffered from malnutrition and a further one in two were at risk (Rintala, 2000). In the study by Soini and co-workers (2004), the risk of malnutrition of elderly people living at home (n=178) and receiving regular home-care services was assessed cross-sectionally. This study revealed that 3% were actually malnourished, 48% at risk for malnutrition, and 49% of the studied elderly individuals had good nutritional status.

Many factors, including changes in food intake, body composition and energy stores, contribute to an increasing risk of malnutrition among elderly people. During a hospital stay the energy and nutrient intake and nutritional status of elderly people often deteriorates, which may contribute to an increased risk of mortality (Sullivan et al, 1999). It is therefore important to understand these risks in order to prevent malnutrition early to ensure the nutritional treatment is most efficient (Sullivan et al, 1999; de Groot et al, 2002; Hickson, 2006).

2.9 NUTRITIONAL SUPPORT OF ELDERLY PEOPLE

Nutritional support includes the assessment of nutritional status, estimation of nutritional requirements, prescription and delivery of appropriate energy, nutrients, and fluids, and ensures that the optimal feeding route is used at all times. It is the basic duty to provide sufficient and required fluids and nutrients to individuals for proper nutritional care (Council of Europe, 2001) (Figure 3). Nutritional care and food are also a source of comfort that can play an important role in adaptation to the nursing home, especially for aged individuals (Evans et al, 2005). The American Dietetic Association (ADA) emphasizes that the relationship of food to culture and personal meaning should also be included in any nutritional treatment (ADA Reports, 2005).

Figure 3. **Plan for nutritional support, care and treatment.**



Nutritional care in long-term settings has two goals: maintenance of health and promotion of quality of life. An unacceptable or unpalatable food may lead to poor food and fluid intake, resulting in weight loss and malnutrition, and a concatenation of undesirable health effects. Elderly residents should be able to participate in diet-related decisions that can increase their desire to eat and enjoy food, thus decreasing the risk of weight loss and of malnutrition (ADA Reports, 2005; Pedersen, 2005). For many elderly individuals in long-term care, it is challenging to ingest food. A lack of assistance with feeding is also common (Cook et al, 2005). Restrictive diets, such as low salt, sugar, and cholesterol or fat may reduce the enjoyment of eating (ADA Reports, 2005). Residents often find these diets unpalatable, which may lead to decreased food intake and weight loss (Kamel et al, 2000). Restrictive diets often create their own challenges, especially among elderly residents when the flavour, variety, or the texture of food are important elements in dining and food intake (ADA reports, 2005).

It has been recommended to carry out corrective nutritional treatment to increase dietary intake and ONS as early as possible (Gillette-Guyonnet et al, 2007). Nutritional treatment seems to have a positive effect on energy intake and weight gain as well as physical activity among aged patients (Morley, 2003; Milne et al, 2006). Timely nutritional treatment can reverse weight loss and produce weight gain (Potter et al, 1998; Akner and Cederholm, 2001). A minimum of 5% weight gain has been associated with increased survival in aged demented residents (Keller et al, 2003).

Because the causes of malnutrition are multifactorial, elderly individuals do not all respond in the same way to the nutritional treatment. It may take longer to reverse weight loss and achieve weight gain in elderly compared to younger people, since ageing may change the metabolic response to nutritional treatment (Hickson, 2006). There is some evidence that especially endurance exercise increase food intake in aged individuals (Fiatarone et al, 1994; Morley, 2001b). Moreover, the comprehensive intervention of the dietician time has promoted significant increase in body weight among people with dementia (Keller et al, 2003).

Nurses often tend to overestimate residents' actual food intake significantly (Pokrywka et al, 1997; Simmons and Reuben, 2000). The lack of documentation of nutritional deficiencies in nursing homes is common (Abbasi and Rudman, 1993). Nurses, caregivers and food service personnel in long-term care facilities need more education about the nutritional problems of elderly individuals to respond to the individual nutritional needs of aged residents (Pokrywka et al, 1997; Barton et al, 2000b; Crogan et al, 2001ab; Lauque et al, 2004). Nutrition education programmes have shown little impact on the attitudes in nutritional care (Christensson et al, 2003), or promising results in increasing nutritional knowledge (Faxen-Irving et al, 2005b) of nurses and result in the prevention of weight loss among elderly residents (Irving et al, 1999; Riviere et al, 2001; Faxen-Irving et al, 2002).

Since malnutrition in institutionalized elderly people has many determinants, it has to be addressed with a multifactorial intervention. The practice of ONS may have positive effects on the energy and nutrient intake as well as physical conditions in the aged, frail people (Akner and Cederholm 2001; Salas-Salvado et al, 2005; Milne et al, 2006). Studies in which the focus has been to offer snacks or enriched food aim to increase the energy and nutrient intake of elderly residents or patients are scarce (Keller et al, 2003; Odlund et al, 2003; Lorefält et al, 2005; Young et al, 2005). In addition, there is a dearth of studies about the effect of meal ambiance on residents' nutrition (Mathey et al, 2001a; Nijs et al, 2006ab).

2.9.1 Oral nutritional supplements

Oral nutritional supplements have usually been the primary intervention when malnutrition and weight loss have been treated, although there has been limited research on how, what amounts and when to use them (Lauque et al, 2004; Young et al, 2004; Simmons and Patel, 2006). ONS seem to reduce mortality and morbidity of malnourished elderly patients (Akner and Cederholm, 2001; Milne et al, 2006) and increase muscle strength (Price et al, 2005). Early provision of ONS immediately after the onset of acute illness has led to weight gain in nursing home residents (Wouters-Wesseling et al, 2006). Moreover, ONS during and after hospitalisation were reported to maintain body weight and increase the MNA score in patients at risk of malnutrition (Gazotti et al, 2003; Potter et al, 2001). ONS are easy for the patients who accept them well and they may help patients maintain the increase in FFM (Lauque et al, 2004).

Furthermore, ONS have been shown to improve nutritional status, eating patterns and energy intake in those institutionalized elderly individuals who respond positively to interventions. In contrast, those elderly who fail to respond to the ONS have actually decreased their total energy intakes after intervention. In other words, temporary supplementation has the potential to cause both beneficial and harmful effects on the usual nutrient intake among an institutionalized, frail population (Salas-Salvado et al, 2005; Parrot et al, 2006). ONS may also destroy residents' appetites and decrease their food intakes during meal times (Kayser-Jones et al, 1998; Fiatarone et al, 2000).

It may be advisable to begin with nutritional supplements before significant weight loss, when they are the most effective (Parrott et al, 2006). ONS have been least useful for subjects with low BMI whereas those likely to benefit from supplementation include those with higher BMIs (Young et al, 2004). In already malnourished aged subjects, it may be too late to expect them to improve their nutritional status or quality of life by providing nutritional supplements (Edington et al, 2004). Certain patients benefit most from nutritional supplementation (Espaulella et al, 2000).

Administering ONS is time consuming and nurses may not be able to adequately carry out the physicians' orders through not having sufficient time to assist residents to take their supplements (Kayser-Jones et al, 1998; Simmons and Patel, 2006). ONS often involve feeding assistance and greater staffing time than usual care during meals and it has been a difficult practice in an institutionalized setting (Simmons and Schnelle 2006). ONS that have been prescribed but not administered adequately is according to Kayser-Jones (2006) medically and morally unacceptable.

2.9.2 Enriched food and menu planning

Some studies have shown with the combination of enriched food and small food portions being positive outcomes for the intake of energy by elderly patients (Barton et al, 2000a; Lorefält et al, 2005) resulting in weight gain as well as increased physical activity (Olin et al, 1996). Fortified food with cream and milk powder as well as snacks has been a convenient method of improving the energy and nutrient intake of hospital patients (Gall et al, 1998). Weight gain during a hospital period (average 21 days) predicted a better 7-year survival among patients with dementia who received nutritional treatment of whole fat dairy products and cream-fortified desserts (Faxen-Irving et al, 2005a).

Meals based on individual nutritional requirements and individual status per se, desires and resources, has increased energy intake, nutritional status and patient's functional capacity (Christensson et al, 2001). Changes in menu and dietary consultation have promoted weight gain in long-term care facilities (Keller et al, 2003). Enhancing the taste and adding flavour to meals has been an effective way to improve food intake and body weight among elderly nursing home residents (Mathey et al, 2001a; Essed et al, 2007). Meals high in carbohydrates have resulted in an increase in the mean energy intake in elderly nursing home residents with AD (Young et al, 2005).

2.9.3 Meal time and meal ambience in nursing homes

Collective mealtimes in nursing homes provide an opportunity to enable residents to socialise with staff and other residents, to make choices according to their personal preferences, and to implement physical care to improve quality of life among aged residents. A social environment at mealtimes may also add a sense of security, and a structure to daily routines (Amarantos et al, 2001). Improving the social and physical ambience during mealtimes counteracts a decline in food intake and in the quality of life for nursing home residents (Mathey et al, 2001b).

Meal ambience includes the atmosphere of the social and physical environment during the meal time (Nijs et al, 2006b). The factors that may contribute favourably to food consumption are food accessibility, time of consumption, ambient sounds, eating locations, ambient temperatures and lighting, colour, sound, smell, texture, portion size, and the presentation of the food (Stroebele and de Castro, 2004). The number of people present during mealtime and eating with others can increase energy intake up to 76% compared to eating alone (de Castro and Brewer, 1992) by simulating a homelike atmosphere and encouraging residents to increase their food consumption (Shatenstein and Ferland, 2000). The change in food delivery system from a preplating service to a more homelike service results in a significant increase in food intakes by nursing home residents (Hotaling, 1990). In elderly patients with AD and patients with low BMIs energy content of the meal has the greatest impact on energy consumed at breakfast and the least impact at dinner (Young et al, 2001; Young and Greenwood, 2001).

Good nutritional care services in nursing homes include family style mealtimes (Nijs et al, 2006ab). Daily energy intake of nursing home residents increase when the meals have been family-style as opposed to residents receiving individual pre-plated service (Nijs et al, 2006b) (Table 4). Family style mealtimes have also prevented a decline in the quality of life, physical performance, and BMI of nursing home residents (Nijs et al, 2006a). The interaction between an elderly individual and the nurses during meals is important and has an influence on the proportion of food consumed (Gillette-Guyonnett et al, 2007).

Maintaining good nutritional status among the elderly residents is the result of team work among the whole staff in institutions and nursing homes. It is the responsibility of the food catering staff that food contains enough energy and nutrients and the dishes are palatable and attractive for the residents. Nurses should be responsible for helping the residents at mealtimes and measuring the nutritional status of the elderly residents. More co-operation is needed to identify individual nutritional needs and to respond to them in a way that enhances their quality of life.

Table 4. Description of different types of mealtimes.

Variable	Family style mealtime	Pre-plated service
Table dressing	<ul style="list-style-type: none"> – tablecloth – drinking glasses – no plastic – complete cutlery – napkins – flowers on the table 	<ul style="list-style-type: none"> – no tablecloth – plastic cups – residents wear bibs
Food service	<ul style="list-style-type: none"> – meals served in dishes on table – individual choice of portion size and the type 	<ul style="list-style-type: none"> – meals served on pre-plated tray far from the ward – resident have very little opportunity to choose individually according to their appetite and fondness to a dish
Staff	<ul style="list-style-type: none"> – staff sit down at tables and chat with residents – drugs handed out before the start of the meal 	<ul style="list-style-type: none"> – staff don't sit down – drugs are handed out – staff leave for lunch when they think nobody needs help – trays and plates should be ready to be washed in time
Residents	<p>Balanced seating of residents.</p> <ul style="list-style-type: none"> – most residents serve themselves, with some help from nurse or table companion – mealtime begins when everybody is seated – before eating there is a moment for reflection or prayer 	<p>Residents cannot change meal if they dislike it.</p> <ul style="list-style-type: none"> – mealtime begins and ends based on logistics or cost-saving
Mealtime	<p>No other activities (for example cleaning, doctor visits).</p> <ul style="list-style-type: none"> – dining room closed for visitor who are not helping or observing – drugs and residents' files have to be out of sight 	<p>Diverse activities take place during the mealtime (cleaning, doctor visits).</p> <ul style="list-style-type: none"> – family and friends walk in and out of the dining room, disturbing other residents

Modified from Nijs and co-workers (2006)

3. THE AIMS OF THIS STUDY AND RESEARCH QUESTIONS

The aims of this study were to investigate the nutritional status, energy and nutrient intake and nutritional care among aged nursing home residents and long-term care patients in Finland.

The following research questions were addressed:

1. What is the nutritional status and its associated factors of elderly nursing home residents and long term care patients in Finland? (Studies I, II and IV)
2. What is the energy and nutrient intake, such as calcium and vitamin D, among elderly residents in dementia wards? (Study I and V)
3. Are the nursing and nutritional care factors associated with the nutritional status? (Studies I, II and III)
4. How do nurses recognize malnutrition? (Study IV)
5. Does the nutrition education of professionals lead to changes in professionals' knowledge and to better nutrition of elderly residents? (Study V)

4. SUBJECTS AND METHODS

4.1 SUBJECTS

All the elderly individuals in the studies of this thesis were living in institutional care settings. In studies II and III residents were living in nursing homes, whereas in studies I and V in dementia wards, and in study IV in long-term care hospitals. All nursing homes and long-term care hospitals for elderly people in Helsinki city administrative area were included in studies II, III, and IV. The dementia wards were in private elderly homes owned by associations working for the benefit of the elderly people and situated in Helsinki (I) and Vantaa (V). The professionals (n=28) who took part into the nutritional education (V) were from five nursing homes situated in various parts of Finland (Table 5).

Table 5. **Description of the studied elderly residents in nursing homes, dementia wards and patients in long term care hospitals.**

Dementia wards (I)	Nursing homes and long term care hospitals in Helsinki		Dementia wards (V)
	Nursing homes residents (II and III)	Long term care patients (IV)	
n=23 residents	n=2 114	n=1 043	n=21 residents
All residents in two wards	87.2% of the eligible residents	72.2% of the eligible patients	Follow up for one year
All women	80.7% women	75.2% women	All women

Study I

In total 105 residents were residing in the nursing home at the time of the study. Of these 23 were living in dementia wards. Residents in dementia wards were assessed during a two-week period in October–November 2001. All the residents suffered from moderate to severe dementia as assessed by the Mini Mental State Examination (MMSE; Folstein et al, 1975). If the test had not been completed during the previous six months before the study commenced, the resident was assessed during the study period.

Studies II and III

In studies II and III the data were collected from all nursing homes in Helsinki in February 2003. The inclusion criteria were long-term residency, availability of sufficient information, and the age 65 years. In February 2003, 1 336 persons were living in private nursing homes (n=16), and 1 088 in public nursing homes (n=4). Of the 2 424 eligible residents, 2 114 (87.2%) were assessed. Those

who refused to participate and who were residing short-term were excluded. The patients or their proxies were given oral and written information for the study. They were told that taking part in the study was voluntary and that they could withdraw from the study any time they want.

Study IV

In study IV the data were collected in all long term care hospitals (n=7) in Helsinki. In 53 wards there were a total of 1 444 patients of which 1 043 aged patients (> 65 y) (72.2%) took part in the study. Those who refused to participate were excluded from the study. A written, informed consent was acquired from the patients or their proxies. They or their proxies were told that taking part in the study was voluntary and they could withdraw from the study at will.

Study V

The data were collected from a nursing home in which a total of 150 residents were residing. Of these, 62 residents were in long-term care. In the wards specialised for dementia care of this nursing home, 21 residents' energy and nutrient intakes were calculated from their respective food diaries. Moreover, 20 residents' nutritional status was assessed, and 20 residents' BMIs were also calculated before and after the professionals' education course. The MNA and BMI data for 19 residents were available both before and after the education sessions. The residents or their proxies were told that taking part in the study was voluntary and they could withdraw from the study at will. They were also told that they could get the results of the assessments and the individual nutritional care plan after the first assessment.

The professionals (n=28) who took part into the nutrition education activities (V) were from five nursing homes situated in various parts of Finland. Of the professionals, 23 were nurses and five were food service caterers. At the beginning of the education course all the personnel in the nursing homes took part in the first information lecture. After the lecture the chief of the nursing home and personnel decided who would take part in the remaining education and assessments. One of these participants was the responsible person in every nursing home.

4.2 METHODS

The data collection methods are described in table 6.

Table 6. **Research questions and used methods in the studies**

Research question	Methods	Sample size
What is the nutritional status of aged nursing home residents and long term care patients in Finland? (Studies I, II, IV, V)	Mini Nutritional Assessment (MNA)	n=23 (I) n=2 114 (II) n=1 043 (IV) n=21 (V)
What is the energy and nutrient intake among residents in dementia wards? (Study I,V)	Precise weighing of consumed amounts of food during three days → energy and nutrient intake	n=23 (I) n=21 (V)
Are the nursing, nutritional care, and other appropriated factors related to malnutrition? (Studies I, II, III)	MNA, structure questionnaire for residents and patients with background, nursing and nutritional care information; the assessment of the nutrient content of served food	n=23 (I) n=2 114 (II and III)
How do nurses recognize malnutrition? (Study IV)	MNA, BMI, structured questionnaire with one question to the nurses	n=1 043 patients n=53 nurses
Does the education of professionals lead to better nutrition of aged residents? (Study V)	MNA, Precise weighing of consumed food during three days, educational process, structured questionnaire to professionals	n=21 residents n=28 professionals

4.2.1 Background information of the residents and patients

For studies II, III and IV the structured questionnaire for residents and patients sought information on the demographic characteristics, functional status, swallowing, mouth problems, the number of medications, and diseases of the residents and patients. The number of medications and the diagnoses of the residents were retrieved from pre-existing medical records.

The information regarding residents' ability to manage their activities of daily living (ADL) was retrieved from their medical records, in which the ADL score according to the last MDS-assessment (Minimum Data Set) had been recorded (Morris et al, 1999). This ADL score measures functional disability based on four factors: locomotion, toilet use, eating, and personal hygiene. The score ranges from zero to six, where zero represents being totally independent and six totally dependent (Morris et al, 1999; Snowden et al, 1999). In studies II, III and IV this variable was dichotomized (0...3 = not totally dependent, 4...6 = dependent). The stage of dementia of the studied residents in study I was defined by the Mini-Mental State Examination (Folstein et al, 1975).

4.2.2 Nutrition related information

Mini Nutritional Assessment

The residents in all five studies were assessed by the Finnish version of the Mini Nutritional Assessment test (MNA), which is available in the website <http://www.mna-elderly.com> -> clinical-practice -> Finnish (Appendix 2). The MNA gives a maximum of 30 points and it classifies an elderly individual as: well nourished, at risk for malnutrition and malnourished (Vellas et al, 1999; Guigoz et al, 2002; Vellas et al, 2006):

1. A score of 23.5 or more classifies an assessed aged person as well nourished. The person's weight should be followed regularly every 6 or 12 months and if significant weight loss occurs, nutritional intervention should be proposed.
2. Scores 17-23.5 indicate that an individual is at risk of malnutrition. These individuals have not usually had significant weight loss or altered biochemical parameters, but have had lower than recommended intake of energy, vitamins and protein. Therefore a detailed nutritional evaluation is needed, as well as review of the medical history, current diseases, oral hygiene, and swallowing ability. Elderly individuals may need to augment total energy and nutrient intake and oral supplements.
3. MNA scores of less than 17 indicates protein and energy malnutrition.

Body mass index

The residents' and patients' heights and weights were measured, and their body mass indexes (BMI) calculated (weight/height^2 ; kg/m^2). In the study I, the nurses weighed the residents with the same scales once a month. Changes in weight during the last three months were easy notice because of this regular weighing. If the height of the resident in all studies was not in their medical records and it was not possible to measure them in the standing position, their heights were estimated from knee height as recommended for the older people who often have difficulties standing straight (studies I, V)(Chumlea et al, 1985). The knee height was converted to standing height with a conversion table.

Nutritional care

In studies II, III and IV nurses gave information about daily routines related to nutritional care and meal management. The use of nutritional supplements and snacks between meals were sought and obtained with yes/no questions.

The proportion of offered food eaten by residents was assessed with the question "How much does the resident on average eat from the main meal" with four options of answers "less than half, half, nearly all or all". This was dichotomized to "eating less than half or half" and to "nearly all or all" categories. The nurses were instructed to compare the average portion of eaten meals with model portions of which they had photos available. Thus, it is possible to achieve accurate estimations of nursing home resident's food items by assessing consumption levels and by comparing meals with accurate values (Andrews and Castellanos, 2003). However, the accuracy is not sufficient to identify those residents who eat less than 75% of most meals (Castellanos and Andrews, 2002). The nurses were instructed to estimate the amount of eaten food and other factors related to the nutritional care over the period of the previous three months.

Questions about how many times per year the nurses check the residents' bodyweight and the control of digestive tract function were also included in the questionnaire. In study IV nurses were asked about their long-term care patients' nutritional status with the question, "Do you think the patient suffers from malnutrition?" (YES/NO).

Vitamin D and calcium supplementation

Information on vitamin D and calcium supplementation were sought and obtained by the questions: "Does the resident receive a vitamin D supplement?" or "Does the resident receive a calcium supplement?" with the options to answer "yes" or "no". We also retrieved all available medication lists from the medical charts (N=2047). Residents receiving vitamin D or calcium supplements according to their medication lists were considered users. Thus, both those answering "yes" in the questionnaire and/or having calcium or vitamin D supplement in their respective medical chart were considered users. Some residents may have received supplements even though supplements were not recorded in their medication lists. The amounts of vitamin D in micrograms (μg) and calcium in milligrams (mg) were obtained from resident' medical charts.

The classes of vitamin D supplementation were divided on the basis of the recommendation of the Finnish National Nutrition Council and the Finnish Current Care guidelines for osteoporosis which are accordingly: 10 μg or 400 IU per day during wintertime for people over 60 years as well as for those residing indoors during the whole year, and 17.5 to 20 μg or 700 to 800 IU for all institutionalized elderly people all year around.

The nutritional assessment of the served food

The energy and nutrient content of the served food including all meals were calculated during a 14-day period (22.10.–4.11.2001) in study I. The energy and nutrient content of the served food including all meals, breakfasts, lunches, dinners and snacks, for a 14-day period was calculated. The recipes were calculated according to preparation for meals in the food service. The average size of a portion was estimated by the food service manager of the nursing home according to that planned for the residents. Breads, cold cuts and drinks were counted as an average portion sizes. The recipes of foods were acquired from the food service manager and from nutritional information on the packaging. For example, the nutrient content of bread was taken from the respective packing labels. The nutritional calculations were done by the Nutrica-program version 3.01 developed using the Social Insurance Institution of Finland (Rastas, 1997).

The energy and nutrient intake of the residents

The food intake of the residents was determined by the precise weighing method over a three day period in studies I and V. Nurses weighed all of each person's daily food before eating and the leftovers after eating for a three day period. The additional snacks eaten by the residents for the study period were investigated by making an inventory of all the food the elderly residents had in their rooms before and after the study days. In addition, all visitors were asked whether they had given the residents anything to eat when visiting.

The precise weighing method in institutional care facilities is a useful method to assess the food intake of those individuals whose memory may be impaired, and when the respondent proxies fill in the food records (Thompson and Byers, 1994). This method has the potential to provide quantitatively accurate information on the food eaten during the study period. However, recording the foods can affect both the types of food chosen and the quantities eaten by the residents (Thompson and Byers, 1994). Diet records may underestimate the individual's actual dietary intake (Livingstone et al, 1990). This is probably due to a result of the combined effects of two factors: the recording is incomplete and the recording process changes the dietary choices (Thompson and Byers, 1994). The food records were analysed by the Nutrica-program (Rastas, 1997).

4.2.3 Educational process

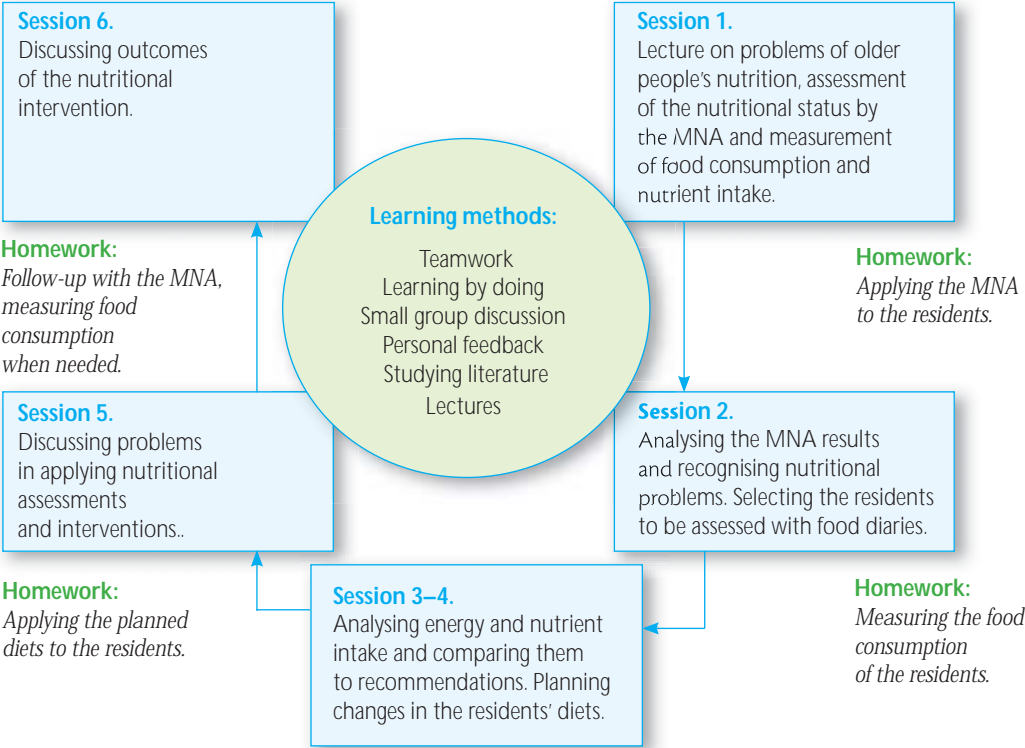
The multiprofessional education in the study V has been described in detail (study V). The education included six training sessions (each two to three hours) with lectures, small group discussions, homework tasks and personal feedback. In the first session the nutritionist gave a lecture on problems of older people's nutrition, assessment of the nutritional status by the MNA and measurement of food consumption and nutrient intake of the residents. Between the first and second sessions, the participants assessed their residents with the MNA test as an assignment. In the second session, the results of the MNA tests were analysed by small groups. Between the second and the third sessions, the professionals weighed all the residents' food before and the leftovers after eating with an electronic scale as an assignment. In the third and fourth sessions, the participants and the nutritionist discussed the results of the MNA tests and food diaries in small groups. Between the third and fifth sessions, the professionals made practical changes to the residents' diets. In the fifth session, the problems related to applying the new diets were discussed with the nutritionist. After the fifth session, the professionals continued to give the new diets, following up on the residents with the MNA and measuring food consumption if needed. After six months, the outcomes of the educational intervention were discussed in the sixth session (Figure 4).

Small group discussions comprising multiprofessional teams, teamwork and discussions with the nutritionist were used as part of the training to respond to problems for residents' nutrition. The professionals were also able to study literature on nutrition made available to them so that they could apply the information individually to the nursing home residents under their care. The basis of the education was constructive learning theory (De Corte and Weinert, 1996; von Wright, 1996) and the reflective learning model (Kolb, 1984; Schon, 1987).

Structured questionnaire for professionals

Immediately after the education ended the professionals completed a feedback questionnaire. The professionals' feedback questionnaire consisted of both open and structured questions about what they considered the most helpful learning methods. The usefulness of the various learning methods was evaluated by a Likert scale ("not at all", "very little", "something", "quite much", "very much"). The questions also sought information on their own learning. They were also asked for their opinions about any barriers to changing the practices in the residents' nutritional care.

Figure 4. **Educational process: Incorporating nutrition as a part of the good care of nursing home residents**



Data collection

In study I under the guidance of the nutritionist a student of nutrition measured the food consumption of 23 residents during the same period of time as the nutrient content of the menus were measured in October–November 2001. In study V under the guidance of the nutritionist the professionals in one nursing home measured the food consumption of residents (N=21) in dementia wards. In both studies all the food prior to eating and the leftovers after eating were weighed over three days. Any additional snacks during the study period were investigated and measured by making an inventory of all the food the elderly residents had in their rooms before and after the actual study days. In addition, the nutrition student or the nurses asked whether relatives and friends had given the residents any items to eat when meeting them. In study V the nurses measured the food consumption of the residents (N=21) before and after the education in January and February 2003 and in January and February 2004. The time between the measurements was one year.

In studies I and V the nurses in the dementia wards assessed their residents' nutritional status using the MNA. The nutritionist guided the nurses to complete the MNA. The nurses helped their residents in answering the questions when needed. In study V the data of the MNA and BMI for 19 residents were available both before and after the education.

In studies II and III the data for all nursing homes in Helsinki were collected over two weeks in February 2003. In study IV the data for long term care hospitals in Helsinki were collected in October 2003. A responsible person was chosen for each ward of the nursing homes and hospitals. This person took part in the educational sessions in which nurses were familiarized with the MNA test and fill in the questionnaire. The contact persons were trained to assess residents and patients using the MNA and with the help of the User's Guide and also how to organize the study in the ward.

4.2.4 Data analysis

In study I residents' food diaries and the food records of the offered food were analysed by the Nutrica-program (I) version 3.01 developed by the Social Insurance Institution of Finland (Rastas, 1997). The means of the energy and nutrient intakes and energy and nutrient content of served food were counted.

In studies II, III and IV the data were analyzed using NCSS or SPSS statistical programs. In studies II and III the differences between men and women at the baseline were tested by a chi-squared test (X^2) for categorical variables and a two-sided t-test for continuous variables. For modeling purposes categorical variables with many levels were dichotomized in studies II and III. Three groups of: well-nourished, those at risk of malnutrition and those malnourished were compared using X^2 test for categorical variables and with analysis of variance for continuous variables. The results were considered as statistically significant if $p \leq 0.05$.

In study II logistic regression analysis was used to determine which variables independently predicted malnutrition. Age, gender and all the variables showing significant differences in bivariate analyses between the malnourished and the others were entered into the model. The results were considered as statistically significant if $p \leq 0.05$.

In the study III groups using vitamin D or not using vitamin D were compared using a chi-squared test (X^2) for categorical variables and with a two-sided t-test for continuous variables. Logistic regression analysis was used to determine which variables independently predicted use of the vitamin D supplements. The results were considered as statistically significant if $p \leq 0.05$.

In study IV the differences between those considered malnourished by nurses and those not were tested using a chi-squared test (X^2) and with a two-sided t-test for continuous variables. The results were considered as statistically significant if $p \leq 0.05$.

In study V the food records were analysed by Aivo –programs (V) (www.aivo.fi). The differences between pre- versus postintervention were tested using a chi-squared test (X^2). The answers to the professionals' questionnaires were analysed both quantitatively and qualitatively. The results were considered as statistically significant if $p \leq 0.05$.

4.2.5 Ethical questions

Studies II, III and IV were approved by the Local Ethics Committee of Helsinki University Hospital, and in study I by the Ethics Committee of the Faculty of Agriculture and Forestry, University of Helsinki. The data in all studies were collected and analyzed anonymously. Patients and their proxies were informed about the studies and their informed consent was an inclusion criterion in all studies.

5. RESULTS

In this thesis the studied elderly individuals were living in institutional care settings and the mean age varied from 81 to 85 years (Table 7). Many of them needed much help in their daily living and eating. In study I it was found that over half of the residents had some difficulties in eating. In studies II and III the mean ADL scores according to MDS was 3.13 and in study IV 69% of the studied patients had ADL according to MDS points 4 to 6 and needed much help in their daily living activities. In study V all the residents were living in the dementia wards.

Table 7. **Background information about the studied patients and residents.**

	Dementia wards (I)	Long term care hospitals and nursing homes in Helsinki		Dementia wards (V)
		Nursing homes residents (II and III)	Long term care patients (IV)	
N	23	2 114	1 043	21
Sex	All women	80.7% women	75.2% women	All women
Mean age	82 y	83 y	81 y	85 y
Dementia	78% of the residents had dementia	70% of the residents had dementia	80% of the residents had dementia	Residents were living in dementia wards
Mean BMI	25.2	23.8	21.6	22.0->21.6*
ADL according to MDS		mean 3.13	ADL 4–6: 69%	

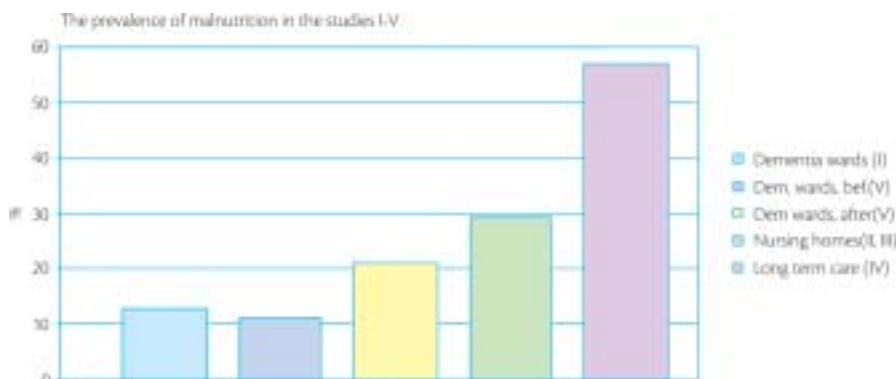
* *before and after intervention*

5.1 THE NUTRITIONAL STATUS OF ELDERLY NURSING HOME RESIDENTS AND LONG TERM CARE PATIENTS

According to the MNA most of the residents in study I were at risk of malnutrition (MNA 17-23.5) and three residents (13%) were estimated to be actually malnourished (MNA<17). In studies II and III 60% of the residents were at risk of malnutrition and nearly one third (29%) of them suffered from malnutrition. In study IV 40% of the patients were at risk of malnutrition and 57% suffered from malnutrition. In study V before the professionals' education 89% of the residents were at risk, and 11% suffered from malnutrition and after these respective percentages were 63/21% (Figure 5).

In study II and III malnutrition was associated with female gender ($p<0.001$), a longer length of time residing in the nursing home ($p=0.02$), functional impairment ($p<0.001$), dementia ($p<0.001$), stroke ($p=0.03$), constipation ($p<0.001$) and difficulties in swallowing ($p<0.001$). In study IV malnutrition was associated with female gender ($p<0.001$), age ($p<0.001$), dry mouth and teeth ($p<0.001$), problems in swallowing ($p<0.001$), and constipation ($p<0.001$).

Figure 5. **The prevalence of malnutrition (MNA<17) in studies I–V according to the MNA.**



5.2 THE ENERGY AND NUTRIENT INTAKE OF ELDERLY RESIDENTS IN DEMENTIA WARDS

In study I the residents' energy intake was on average 1205 kcal/day (5.4 MJ) per day, and in the study V it was before the professionals' education 1230 kcal/day (5.5 MJ). In study I the proportion of protein in the total energy was 19.5 E%, whereas the proportion of total fat was 28.2 E%. In study V before the professionals' education the proportion of protein was 17.1% and the proportion of fat 34.4%. The intakes of vitamin D, E and folic acid were less than recommended in both studies (Table 8).

Table 8. **Description of energy and nutrient intake of the studied aged residents in dementia wards**

The mean intake of residents/day	Dementia wards (I)	Dementia wards (V), before education	Recommendation* Age 75+, female
Energy	1 205 kcal (5.4 MJ)	1 230 kcal (5.5 MJ)	1 570–1 850 kcal (6.5–7.7 MJ)
Protein (g)	58.6	50.4	–
Calcium (mg)	1 004	896	800
Folic acid (µg)	163	177	300
Vitamin C (mg)	59.1	92.9	60
Vitamin D (µg)	1.7	2.5	10
Vitamin E (mg)	4.4	4.4	8

* National Nutrition Council, 1999

In study III one in three (32.9%) of these nursing home residents received vitamin D supplementation, and 20.0% of them received both vitamin D and calcium supplementation. The dose of residents' vitamin D supplementation was 3 µg to 40 µg (120 to 1600 IU). One in five (21.2%) of all studied residents received vitamin D supplementation 10 µg (400 IU) or more. Only 3.5% of residents received 20 µg/800IU or more of vitamin D.

5.3 NURSING AND NUTRITIONAL CARE FACTORS

In study I the energy and nutrient content of served food in dementia wards was sufficient or substantial, but the residents ate less than the food service staff had planned. If the residents had eaten all the food that was planned, they would have received 1665 kcal (7.4 MJ) of energy per day. In these wards two (2/23) residents received vitamin D supplementation.

In study II malnutrition was associated with eating less than half of the offered food portions ($p<0.001$), not eating snacks between meals ($p<0.001$), constipation ($p<0.001$), and pressure sores ($p<0.001$). In logistic regression analysis when age and gender were used as covariates, malnutrition was predicted by constipation and eating less than half of the offered food portions. The use of ONS was very rare, only 4% of the residents received such supplements.

In study III female residents, those who received snacks between meals ($p<0.001$), and whose weight was checked frequently ($p<0.001$) were administered vitamin D more often than others. Those residents who suffered from malnutrition ($MNA<17$) were administered vitamin D less often than those who were at risk of malnutrition or had good nutritional status ($p=0.005$). In logistic regression analysis in which age, gender, malnutrition, poor ADL, lactose intolerance, constipation, previous hip fracture, eating half or less from the offered food portion, and weight control yearly or less often were used as covariates, revealed that vitamin D supplementation in doses of 10 µg or more was predicted by eating snacks (OR 1.65, 95% CI 1.25–2.17). Weight checking yearly or less often (OR 0.47, 95% CI 0.27–0.81) and malnutrition (OR 0.57, 95% CI 0.42–0.79) were risk factors for inadequate use of vitamin D supplements.

In study IV those patients that the nurses considered to be malnourished received fewer snacks and ONS than those that nurses considered to have normal nutritional status. Only one in six of the malnourished patients received ONS. Of the malnourished patients, a significantly smaller proportion ate more than half of their food portions ($p<0.001$) or received snacks ($p=0.01$) than those considered well nourished. They also received fewer snacks between meals than those considered to have normal nutrition

5.4 THE RECOGNITION OF MALNUTRITION

The nurses recognized malnutrition in only one in four (26.7%) of the actual cases among long term care patients, although the MNA revealed that 56.7% were malnourished ($MNA < 17$ points). Those patients considered by the nurses to have malnutrition had a mean weight of 45.0 kilos and their BMI was 17.2 kg/m². Nurses considered only 34.4% ($N=107$) of those patients who had a BMI less than 20 kg/m² and $MNA<17$ ($N=311$) as being malnourished. For those patients who had good nutritional status ($MNA>23$) nurses did not consider as having malnutrition, so there were no false positives in their evaluations. The results have been described in detail in the study IV.

5.5 EDUCATION OF PROFESSIONALS

5.5.1 Professionals

In the training process that included six half-day sessions and homework, the professionals learned to use and to interpret the MNA and detailed food diaries. Keeping the food diaries and analysing them in multi-professional teams was considered as the main source for learning insights. Assessing the residents with the MNA was also found to be useful. Reading the literature and studying alone were considered the least useful methods in the learning process. After calculating the diets and discussing with others, the professionals felt easier to respond to the nutritional problems of the residents. The results in professionals' learning have been described in detail in study V.

5.5.2 Residents

In study V the energy intake of residents increased by 21% ($p<0.01$) from 1230 kcal/day (5.5 MJ) to 1487 kcal/day (6.7 MJ) (Table 9). The proportion of protein before and after professionals' education were 17.1% and 17.2%, and the proportion of fat 34.4% and 35.3% respectively.

Residents' mean BMI was 21.7 kg/m² before the education and 21.4 kg/m² after the education. Weight gain occurred in 42% of the residents, but another 42% of them lost weight. Before the education none but after the education 16% (3 of 21) of the elderly subjects had a good nutritional status according to the MNA test. However, the number of those who suffered from malnutrition increased from two to four residents. The results have been described in detail in study V.

Table 9. **Description of energy and nutrient intake of the studied aged residents in dementia wards before and after professionals' education.**

The mean intake of residents	Dementia wards (study V)	
	Before education	After education
Energy (kcal/MJ)	1 230/5.5	1 487/6.7
Protein (g)	50.4	60.9
Calcium (mg)	896	1 099
Folic acid (µg)	177	219
Vitamin C (mg)	92.9	106.0
Vitamin D (µg)	2.5	5.3*
Vitamin E (mg)	4.4	4.4

* Includes the fortification of milk products 0.5 µg/100g

6. DISCUSSION

The purposes of this series of studies were to investigate the nutritional status, energy and nutrient intake, factors related to nutritional status, and nutritional care options available to nursing home residents and long-term care patients in Finland. Malnutrition was common among elderly residents and patients living in nursing homes and hospitals. According to the MNA, 11% to 57% of the elderly people studied actually suffered from malnutrition, and 40% to 89% were at risk of malnutrition, whereas only 0% to 16% were in good nutritional status. Resident- and patient-related factors such as dementia, impaired ADL, swallowing difficulties and constipation mainly explained the malnutrition. However, some nutritional care factors also had a bearing. These included eating half or less of the offered food portions and not receiving or consuming snacks, and were related to higher incidence of malnutrition. The intakes of energy and some nutrients by the residents in dementia wards were low. The proportion of residents receiving vitamin D supplementation was also low, even though there are known recommendations and also known benefits for adequate intake of vitamin D. Nurses recognized malnutrition poorly, only in one fourth (26.7%) of the actual cases. Nutrition education for the professional carers had a positive impact on the energy intake, protein intake, the BMIs, and the results of the MNA tests of some frail residents in dementia wards.

6.1 METHODS

The MNA

In all studies residents' and patients' nutritional status were assessed with the MNA, which has been used to assess ~35,000 aged people's nutritional status over many studies (Guigoz, 2006). The MNA is a simple, reliable, well-validated scale and it has good sensitivity (Green and Watson, 2006; Guigoz, 2006). There are also other tools that have been developed for the assessment of elderly people's nutritional status, but the MNA is the most extensively evaluated method for this purpose (Green and Watson, 2006). Moreover, it is suitable for systematic and large studies (Compan et al, 1999), in which the screening of frail elderly people's nutritional status in medical care, in hospitals, and in nursing homes is required (Lauque et al, 2000; Gazzotti et al, 2003). For these reasons it is also suitable for assessing the nutritional status of the elderly people in the studies presented in this thesis.

The limitation of the MNA is that elderly people with dementia are not able to respond directly to the questions. Therefore proxies answer on behalf of residents and patients (Sieber, 2006). Most of the studied elderly individuals suffered from dementia. When proxies filled in the MNA, the results may correspond more to the view of the nurses than to the actual situation of the patients and residents. In the educational study (V) nurses' opinions may be a very important factor to consider, because after professionals' education nurses were aware of the consequences of poor nutritional status. This may subsequently have affected their evaluation and answers to the questions in the MNA. The MNA was developed for nutritional screening and its quality in intervention studies (study V) may be questioned (Vellas et al, 2006).



Food and nutrient intake

The actual food and nutrient intake of residents in dementia wards was assessed by the precise weighing method over a three day period. Since food service in nursing homes and long-term care hospitals are similar from day to day, food recording over three days was regarded sufficient. Nurses weighed and recorded all the food offered to residents before eating and leftovers after eating. This method may have underestimated residents' usual food intake (Thompson and Byers, 1994), thus the residents' mean energy intake in the studies I and V may have been more than that actually recorded 1205 kcal (5.4 MJ)/1230 kcal (5.5 MJ). In study V residents' energy and nutrient intake were assessed before and after professionals' nutrition education. Professionals' knowledge during the education had increased and they had begun to understand better elderly people's nutritional problems. This knowledge may have caused some changes in the recording process (Thompson and Byers, 1994), for instance nurses may have chosen food items containing more energy in the second food recording.

The residents' food portions were assessed under four categories according to the actual intake and consumption in studies II and III. Although it is possible to achieve accurate estimation of food consumption by assessing the eaten food portion, this method has been reported to be imprecise at identifying those who eat very little (Castellanos and Andrews, 2002). In addition, nurses often overestimate residents' actual food intake (Pokrywka et al, 1997). For these reasons, there may be both overestimation of food intake and underrecognition of those residents who ate only very little.

Subjects

All nursing homes and long-term care hospitals in Helsinki took part in studies II, III and IV. The study populations were large and included 87.2% (N=2114) of the eligible residents in nursing homes, and 72.2% (N=1043) of the eligible patients in hospitals. Therefore these data are reliable as they have a high statistical power and are highly representative of the elderly residents and patients, who live permanently in nursing homes and long-term care hospitals, especially in big towns in Finland.

In studies I (n=23) and V (n=21) the numbers of the study persons were small, but the strength of study I is that the whole process from the food preparation to the nutrient intake and nutritional status of the residents was studied and described in detail. Study V described residents' nutrient intake and nutritional status before and after professionals' nutrition education, and additionally the evaluation of the professionals' learning. However, it is not easy to assess the whole process of nutrition in institutions from food preparation until to detailed nutrient intake and nutritional status of residents as in the study I. Nevertheless the results of these smaller studies are important for generating ideas for future randomised trials and for development of nutritional care practices in elderly care.

6.2 MALNUTRITION AND NUTRITIONAL CARE

Nutritional status and associated factors of elderly residents and long-term care patients

Malnutrition and its consequences in the elderly population have been objects of growing interest worldwide during the past decade (Fried et al, 2004; Vellas et al, 2006). In nursing homes in Helsinki nearly one in three (29%) of the residents, and over half of the patients (57%) in long-term care hospitals was found to suffer from malnutrition. The prevalence of malnutrition and its resident- and patient-related associations observed in the studies of this thesis are well in line with those of previous studies (Lauque et al, 2000; Saletti et al, 2000; Van Nes et al, 2001; Christensson et al, 2002; Gerber et al, 2003; Guigoz, 2006). In a Swedish study (Saletti et al, 2000) 33% of those living in old people's homes suffered from malnutrition which corresponds to the results in the study II in nursing homes (29%). According to the review of Guigoz (2006), the proportion of residents, patients, and cognitively impaired elderly suffering from malnutrition varies between 1% and 74% and the risk for malnutrition between 8% and 87% for the 79 published studies.

In the studies that used the MNA poor nutritional status has been associated with many illnesses such as dementia, depression, pressure ulcers, stroke, falls, and hip fractures, increased in-hospital mortality, a higher rate of admission to nursing homes and a longer length of stay in hospitals (Compan et al, 1999; Van Nes et al, 2001; Milne et al, 2006). In the study of nursing home residents (II) malnutrition was also associated with dementia, functional impairment, stroke, swallowing difficulties and constipation.

Studies on elderly people's nutrition in Finland and especially on those who are frail and live in institutions (Laakkonen et al, 1991; Rajala, 1991; Rintala, 2000) or at home (Rissanen et al, 1996; Soini et al, 2004) have been scarce. Large-scale studies using MNA have not been carried out earlier in

Finland. Soini and co-workers (2004) studied home care patients' nutritional status (n=178), and Rintala in her graduate thesis (2000) on institutionalized elderly people's nutritional status (n=91), both studies used the MNA. In one of these studies (Rintala, 2000) more than one in four of the residents and patients were found to suffer from malnutrition and over half were at risk of malnutrition. Such results are also well in line with the results of the nursing homes (study II) of this thesis. The use of a descriptive and cross sectional design to investigate this topic and form an overall picture for the future development and study design in this area was appropriate therefore.

Energy and nutrient intake

Residents of dementia wards in studies I and V ingested energy and many nutrient less than recommended, although as the intervention showed (study V) it was possible to increase residents' mean energy and nutrient intakes. Inadequate energy and nutrient intakes by elderly residents and patients has been a common finding in other studies (Rajala, 1991; Eastwood et al, 2002; Schmid et al, 2003). The mean energy intake has been reported to vary from 900 kcal/d to 1764 kcal/d (Delmi et al, 1990; Young and Greenwood, 2001; Eneroth et al, 2005; Lammes and Akner, 2006; Parrot et al, 2006) whereas the intake of micronutrients varies between 40 and 90% from the recommended level (Schmid et al, 2003). In a study by Vellas and co-workers (2000), the MNA scores correlated to energy and nutrient intake of hospitalized, elderly patients. Similarly, those elderly individuals who are at risk for malnutrition (MNA 17 to 23.5) are likely to have decreased energy intake that could be corrected with nutritional intervention (Vellas et al, 1999).

The low energy and low nutrient intake observed in our studies may have been a result of many factors. According to a study by Pokrywka and co-workers (1997), nurses tend to overestimate the energy content of small food portions. In the feedback discussions with the staff, the nurses were surprised by the low energy intake of the residents (studies I, V). They had anticipated that the food intake had fulfilled most of the residents' energy needs. Meals, from breakfast to the evening meal, were offered during too short a period of time (study I), and the residents did not have enough time to develop a good appetite. The proportion of total energy from fat in study I was close to the recommended level. However, fat enriched food and in small food portions can enhance the energy intake of elderly residents who only eat small food portions (Barton et al, 2000a; Lorefält et al, 2005). In addition, with only a minimum knowledge of nutrition the staff in nursing homes simply follow the nutrition recommendations mainly intended for middle-aged people with overweight problems. Such recommendations are definitely not suitable for elderly residents and patients. A balanced diet is the best way to avoid nutritional deficiencies, but in subgroups of elderly people with frailty and many illnesses, an adequate nutrition may require special nutritional support in the form of ONS and fortified foods. New dietary guidelines for the needs of frail, elderly individuals with low food intake have been suggested (Wendland et al, 2003). Our results also raised the need for guidelines directed to this frail group of elderly people.

The proportion of residents receiving vitamin D supplementation was low (32.9%), and the dose of the supplement small: only one in five of the residents received supplements according to the recommendation (National Nutrition Council, 2005) 10 µg or more (study III). In other studies vitamin D supplementation has been prescribed to 32% (Gupta and Aronow, 2003) and 9% (Kamel, 2004) of nursing home residents, and the dosage has varied from 5 µg to 20 µg (Gupta and Aronow, 2003). There may be a few reasons why the recommendation of vitamin D supplementation has not been implemented in practice. A lack of specific education, the cautious portioning because

of the fear of vitaminosis of lipid-soluble vitamins, cost of supplementation, and also the avoidance of polypharmacy may be reasons not to administer supplements. Nonetheless, vitamin D supplements could be administered to residents in bigger doses, which is practical and also safe (Vieth, 1999).

Nutritional care

Nutritional care and treatment may have positive effects on the energy and nutrient intakes as well as the quality of life of elderly residents and patients who suffer from malnutrition (Barton et al, 2000a; Akner and Cederholm, 2001; Potter et al, 2001; Milne et al, 2006; Nijs et al, 2006ab). Proper nutritional support requires the assessment of elderly individuals' nutrition on the basis of the assessment of their nutritional status to the nutrition care plan, since all elderly people do not respond in the same way to the nutritional care (Hickson, 2006). Studies II, III and IV in this thesis were the first large-scale nutrition studies of elderly people who live in institutional care settings in Finland. Nurses' knowledge of nutritional issues was found to be inadequate. It is possible therefore that nutrition care measures for the care of elderly people had not been used to their full potential. The lack of sufficient education has been mentioned as one of the major problems common in the context of malnutrition (Beck et al, 2001).

In study II those residents who did not receive snacks and who ate less than half of the offered food portions suffered more often from malnutrition than those who ate more, although it was not possible to conclude whether illnesses or difficulties in eating were the main reasons for eating only a little. According to the results of study II nurses were aware that many of the residents ate only parts of the offered food portions and didn't eat snacks, even though in the feedback discussions in study I and then later in study IV nurses expressed their surprise at how little energy residents actually ingested. The lack of documentation of nutrition in nursing homes is prevalent (Abbasi and Rudman, 1993; Pokrywka et al, 1997). The absence of documentation on nutritional issues in nursing homes and long-term care hospitals in Finland may have caused confusion about the assessment of food and energy intakes of residents and patients in our studies. Nurses caring for the elderly should be educated so that they are aware of the risks that lead to malnutrition. More education and simple methods for assessing food and nutrient intake of elderly residents and patients are needed.

Nutrition issues in nursing homes seem to be given a lower priority than other nursing care activities (Xia and McCutcheon, 2006). In our studies the use of ONS and energy-dense meals were rare in nursing homes (study I and II), and only one in six of those long-term care patients, who were considered malnourished by nurses received ONS (study IV), although it is known that ONS reduce weight loss and mortality (Potter et al, 2001) and increase MNA scores in elderly patients (Gazzotti et al, 2003). Vitamin D supplementation was given to only one in three of the studied residents (study III). Several factors related to the overall good care of residents, such as regular weighings, treatment for constipation and offering snacks between meals, were associated with the vitamin D intake. Thus, our studies suggest that better quality in the care of residents also assures the nutritional related care, such as offering ONS, energy-dense meals, and vitamin D supplementation.

The recognition of malnutrition

Malnutrition was recognized in only one four (26.7%) of the actual cases in long-term care hospitals (study IV), and all the patients nurses considered malnourished were indeed malnourished or at risk of malnutrition according to the MNA. Nurses' evaluations were highly specific but very poor at detecting true malnutrition. In a study by Kelly and co-workers (2000) malnutrition in acute hospitals was unrecognized in 70% of cases. Our results are in line with prior studies in which protein-energy malnutrition was found to poorly recognized (Mowe and Bohmer, 1992; McWhirter and Pennington, 1994; Kelly et al, 2000).

Many older patients suffer from malnutrition even those with high BMIs. Of those considered as malnourished by MNA evaluation, 35.3% had a BMI 20 or more and 11.2% a BMI in excess of 24. Malnutrition, obesity and frailty are often coincident in very old people (Villareal et al, 2004; Roubenhoff, 2004). It is not easy to recognize malnutrition and sarcopenia among elderly individuals who have retained their fat mass. Morley (2001c) calls such individuals "fat frail".

Awareness of nutritional problems and the possible measures for nutritional support for elderly individuals has risen during the last years. Moreover, nutrition screening guidelines have been published (Kondrup et al, 2003). Yet our study shows that these guidelines have not yet been implemented in practice. The proportion recognized as malnourished by nurses was strikingly low and it adversely impacts on good nutritional care. In addition, the causes of malnutrition are multifactorial, and all elderly individuals may not respond to nutritional treatment. It is important to identify malnutrition early enough and to begin nutritional treatment as early as possible (Hickson, 2006).

The limitation of study IV is that the nurses who filled in the MNA also answered the questions concerning their opinions on the patients' malnutrition. Even so, they still widely underrecognized their patients' malnutrition. Thus, our results could be an underestimate rather than an overestimate of the true situation of how effective nurses pay attention to nutritional problems among their patients.

Nutrition education of professionals

The nutrition education of professionals in nursing homes had a positive impact on the mean energy and protein intake, BMIs, and the results of the MNA of many frail residents in dementia wards. After assessing the residents' nutritional status, calculating the energy content of their diets and discussing nutritional matters in the multi-professional teams, the professionals expressed the opinion that it was practical and easy to respond to the residents' nutritional needs and make the necessary changes to their diets.

The education of nurses and general practitioners in order to increase their knowledge about factors affecting malnutrition in the elderly is important since often serious consequences arise from malnutrition (Pokrywka et al, 1997). Our small study shows that adult education based on constructive learning theory may have real positive effects on the nutrition of elderly residents. To our knowledge the outcome among frail and old residents living in dementia wards has rarely been examined. Some studies exist which show promising results resulting from increasing the nutritional knowledge by education of nurses, by preventing weight loss (Irving et al, 1999; Faxen-

Irving et al, 2002) and cognitive decline in Alzheimer's disease (Riviere et al, 2001) among elderly residents. However, it is easier to show the effect of education on the learning outcomes of professionals (Crogan et al, 2001ab) than its impact on changing the actual practice of nutritional care or positive changes in the nutrition of elderly residents (Riviere et al, 2001; Faxen-Irving et al, 2002; Lauque et al, 2004). Two studies have reported improvement in both learning outcomes of professionals and the outcomes on the nutrition of elderly residents (Irving et al, 1999; Faxen-Irving et al, 2005). Even so, the process of education in these studies has not been opened up in detail and therefore they cannot be implemented in further practice.

Keeping and analysing food diaries and reflecting on nutritional issues in small group discussions were an effective training methods for professionals. The nurses and the food service personnel expressed their surprise about how little energy the residents had received before the education. The professionals had not understood the connection of nutrition to the comprehensive well-being of aged residents before the education. The professionals were very motivated to respond to residents' nutritional problems after calculating their diets and nutritional status. After learning about these issues, they felt that it was easier to respond to the nutritional problems and accordingly to make the proper necessary changes to the residents' diets.

The real increase in residents' energy intake may have been smaller for two reasons: the underestimation of food intrinsic to the method, and by the professionals' improved knowledge in nutritional issues. The nutritional status of some of the residents was better after the intervention, which may also have been influenced by the increased knowledge of the professional who filled in the residents' MNA forms. The number of the studied residents who took part to the intervention is small and the result must be considered as a pilot result, which need to be proved by a randomised trial with more statistical power.

In an earlier study (Pokrywka et al, 1997) it was reported that nurses tend to overestimate the energy content of small portions of food. In our studies I and V, the nurses were surprised at the residents' actual energy and nutrient intake. Nutritional care measures were minimally used in all studies. In study IV nurses recognized malnutrition in only one in four of the actual cases. It may be speculated that this kind of situation has worsened the nutritional status and its consequences for many of the frail elderly in care.

There are studies on elderly people's malnutrition and nutritional care measures from other countries (Akner and Cederholm, 2000; Milne et al, 2006). In Finland elderly people's malnutrition has not been in the main focus of interest, research or discussion. The significance of the descriptive studies of this thesis will hopefully raise this subject to a greater general awareness and to create the basis for future studies in this area.

New nutritional guidelines for the needs of frail, elderly individuals with low food intake are needed (Wendland et al, 2003). These guidelines should include defining the dietician's role in overseeing residents' nutritional needs, and in training, supervising, and motivating foodservice personnel (Shatenstein and Ferland, 2000). In addition, they should include the responsibilities of various staff categories, and the role of the nursing home and or hospital management in nutritional support of elderly individuals. In addition, an improvement in the educational level of staff groups is needed.



7. CONCLUSIONS

1. Malnutrition was common among elderly residents and patients living in nursing homes and hospitals. According to the MNA, 11% to 57% of the elderly people studied actually suffered from malnutrition, and 40% to 89% were at risk of malnutrition, whereas only 0% to 16% were in good nutritional status. Resident- and patient-related factors such as dementia, impaired ADL, swallowing difficulties and constipation mainly explained the malnutrition.

2. The intakes of energy and some nutrients by the residents in dementia wards were low, although it was possible to increase residents' mean energy and nutrient intakes. The proportion of nursing home residents receiving vitamin D supplementation was also low, even though there are known recommendations and also known benefits for adequate intake of vitamin D.

3. Some nutritional care factors were associated with the nutritional status. These included eating half or less of the offered food portions and not receiving or consuming snacks. Residents in dementia wards ate less than the food service had planned, and the nurses were surprised by the low energy intake of the residents.

4. Nurses recognized malnutrition poorly, only in one four (26.7%) of the actual cases. All the patients nurses considered malnourished were indeed malnourished or at risk of malnutrition according to the MNA. Nurses' evaluations were highly specific but very poor at detecting true malnutrition.

5. Nutrition education for the professional carers had a positive impact on the energy intake, protein intake, the BMIs, and the results of the MNA tests of some frail residents in dementia wards. After assessing the residents' nutritional status, calculating the energy content of their diets and discussing nutritional matters in the multi-professional teams, the professionals expressed the opinion that it was practical and easy to respond to the residents' nutritional needs and make the necessary changes to their diets.

8. IMPLICATIONS FOR THE FUTURE

Malnutrition among institutionalized elderly people in Finland was widespread and poorly recognized. Energy and nutrient intakes of residents in dementia wards was found to be lower than those recommended by professional bodies. Nutritional care measures were minimally used, but professionals' nutritional education had a positive impact on the nutrition of elderly residents.

1. Assessment of elderly nutrition

Although resident- and patient-related factors mainly explained the poor nutritional status of aged residents and patients, nutritional care actions in caring for residents and patients were underused. It is important to: assess elderly individuals' nutrition, pay attention to nutritional problems, use more nutritional supplements, and provide energy and protein-dense food which might delay malnutrition or even improve the nutritional status of elderly residents and patients. Simple methods for assessing nutritional status as well as food and nutrient intake of elderly residents and patients are needed.

2. Education of professionals

Professionals who take care of elderly people are not specially trained in nutritional problems of elderly people. It was useful to educate professionals near to their daily work to emphasize the relevance of good nutrition for nursing home residents, which may be converted to actual improved nutrition of elderly residents. The education and consequent changes in nutritional care increased the mean energy intake and improved the results of the MNA tests of some frail residents. The professionals felt that the nutrition education helped them very much in their daily work. It resulted in many insights into nutritional care. Education of nurses and general practitioners is urgently required in order to increase awareness about malnutrition and nutrition care measures.

3. Nutrition recommendations

Although the awareness of nutritional problems and initiatives of nutritional treatment among elderly have risen in recent years, there is still a need of nutrition recommendations specifically aimed at frail, elderly people. Because of the lack of nutritional education and clear recommendations for this age and health category, nurses usually use the general recommendations directed at middle-aged people with problems of overweight, and not those specifically aimed at aged residents or patients with malnutrition and weight loss. Clear dietary guidelines directed at frail, elderly people are needed.

4. Co-operation of the staff

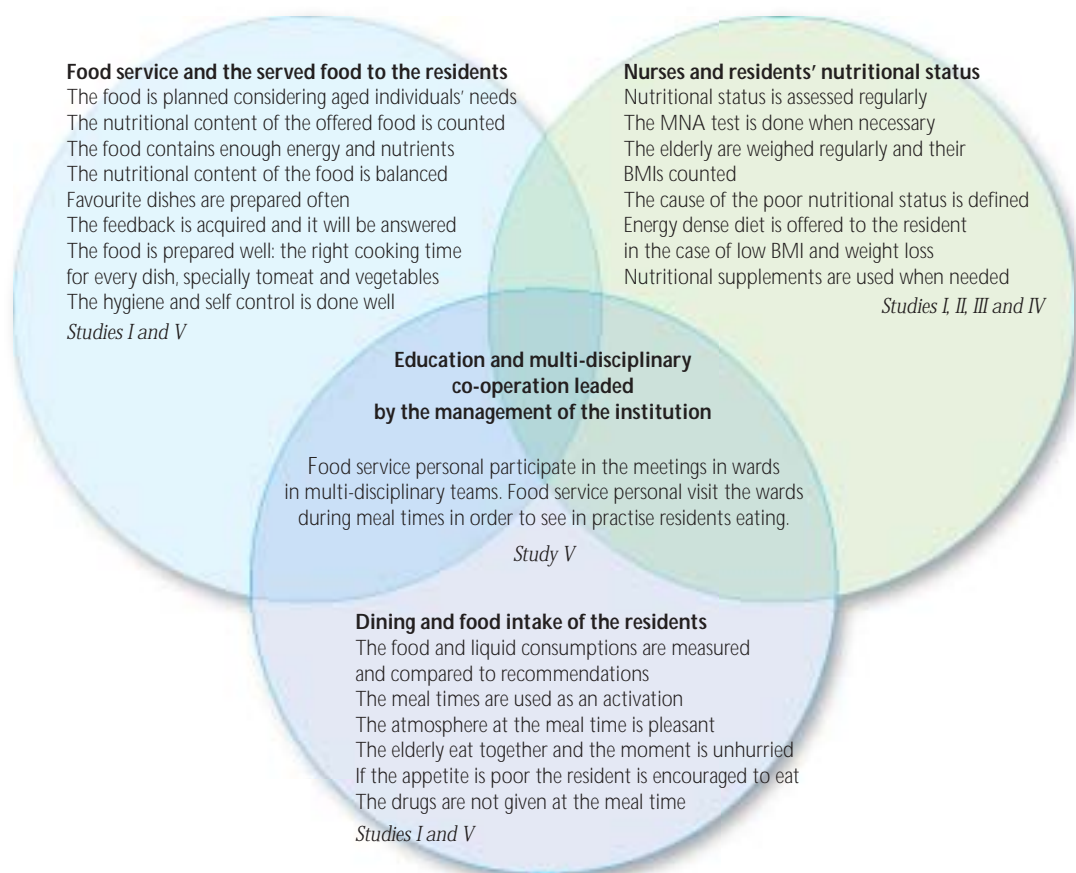
Good nutrition for elderly residents results from the co-operation of all the staff lead by the management of nursing homes and long-term care hospitals. Food service staff have the responsibility to ensure that the food offered contains enough energy and nutrients and the dishes are palatable and attractive for the residents. Nurses are responsible for helping the residents at mealtimes and for measuring the nutritional status of the elderly residents. More co-operation is required to

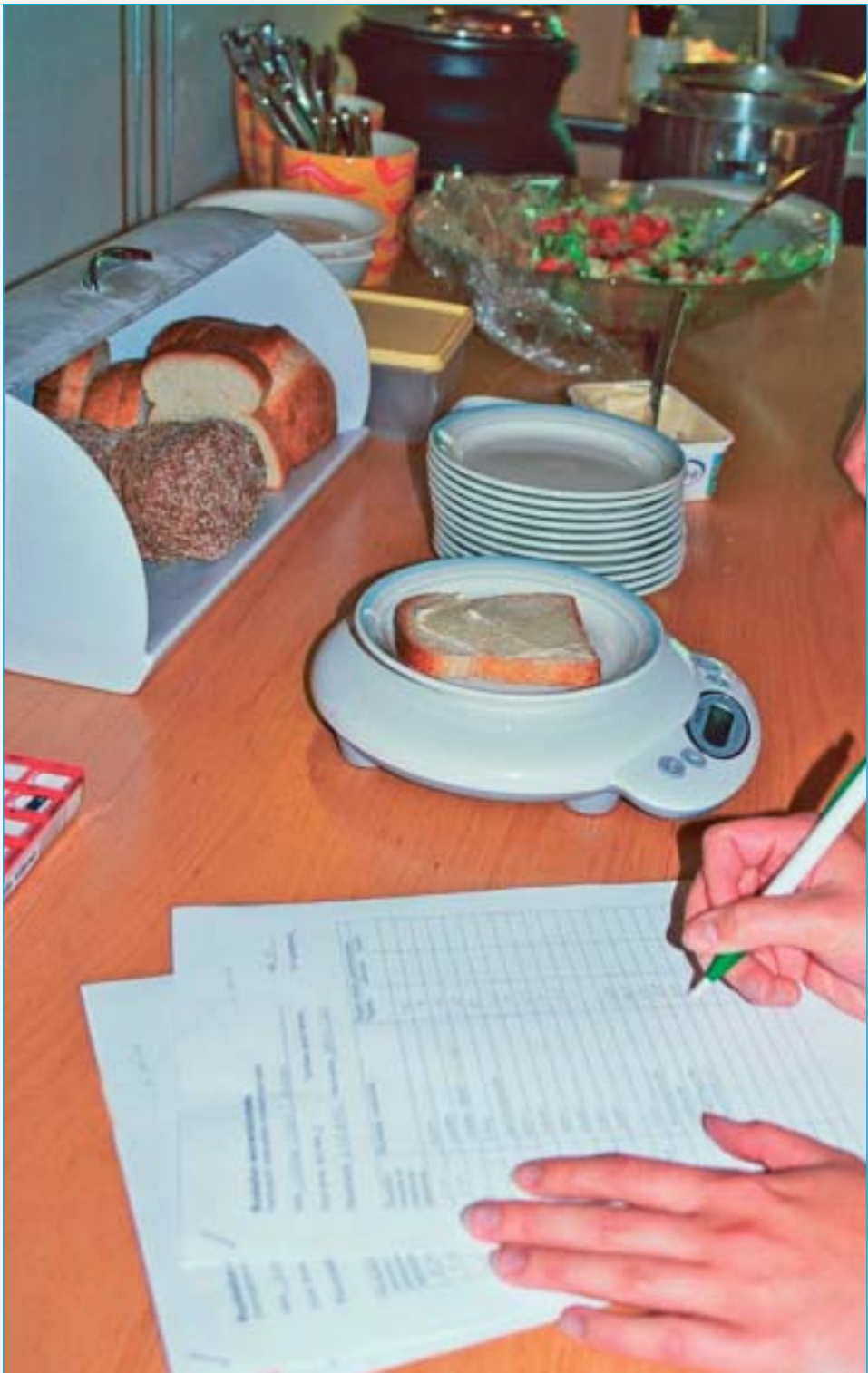
identify the risk of malnutrition and individual nutritional needs of elderly resident and patients (Figure 6). To be able to respond to individual needs of the residents, requires adequate knowledge and education in nutrition of the elderly by the staff of the nursing homes and long-term care hospitals.

5. Future studies

These studies are mostly descriptive of the situation of long-term care residents' nutritional care in Finland. They reveal possible steps to improve care in this field. Future research should focus on providing more data to evaluate these gaps. Thus, there is a need for randomised controlled trials in the whole chain of nutritional care: from the education of professionals and improvement in food delivery to the interventions focused on residents to improve their energy and nutrient intake. The outcome of these studies should include both measures for changes in nutritional care and practice as well as the ability to accurately evaluate residents' nutritional status, and functional abilities.

Figure 6. **Actors in different disciplines aimed at good nutrition for aged residents:** the served food, food intake and the assessment of the nutritional status of nursing home residents in the multi-disciplinary-team.





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Studies I and V are part of a larger study, which The Central Union for the Welfare of the Aged in Finland has organized in order to emphasize the nutritional aspects of good care of the elderly on the levels of research, information and practice. Studies II, III and IV are part of a larger study, which the City of Helsinki has organized in order to develop the nutritional care of the elderly patients and nursing home residents.

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Appendix 1 **Mini Nutritional Assessment (MNA) in English**72

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Five generations of the Suominen and Koskinen families, mid-1950s, in Uramo, Riihimäki.

Mummoilleni ja muille isovanhemmilleni, joilta olen oppinut, että vanheneminen voi merkitä viisautta, välittämistä ja keskinäistä arvostamista.

To my grandmothers and other grandparents from whom I have learnt that getting old can mean wisdom, caring and appreciation.

Merja Suominen